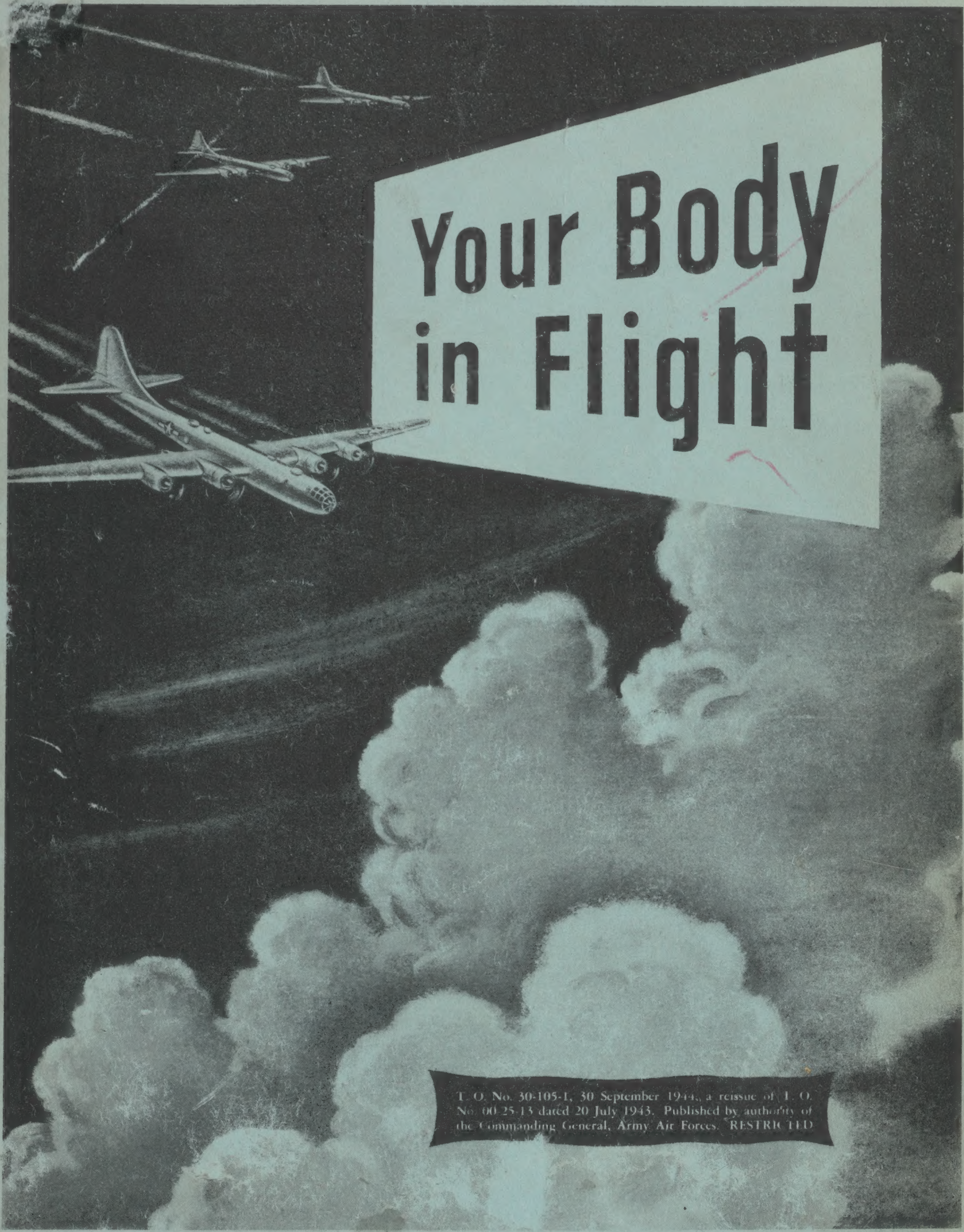
Your Body in Flight
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Your Body in Flight

U. S. Aero Medical Laboratory, Dayton, Ohio

THE OTTERBEIN PRESS, DAYTON, OHIO
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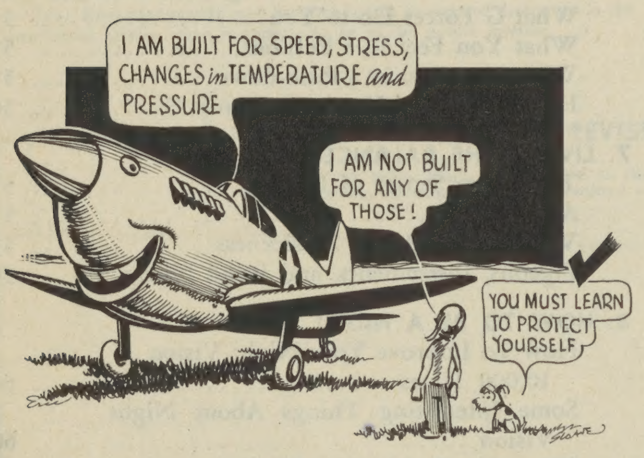
WHY YOU SHOULD READ THIS BOOK



Your main job is to drop your bombs on the target and to make your fire-power count.

That can't be done unless *every* man is "on the ball," be it at the controls, the navigation charts, the bomb-sight, the radio, or the guns.

You *can't* do *your* job if you are

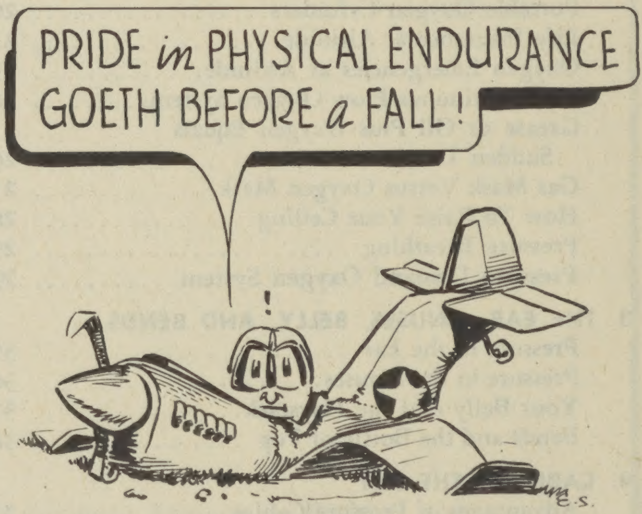
—punch drunk from oxygen lack
—almost blind because of poor night vision
—crippled because your hand is frost-bitten
—incapacitated by pain in the ears or sinuses

All of these are avoidable!! This book tells you how you can avoid them.

You will be living and fighting in a world from 3 to 9 miles above the environment for which nature designed you. Your *plane* was built for that world! You were not *built* for it, but if you use the protection with which the Army Air Forces provides you, if you "know your stuff" and if you use your head, you will get along *fine.*

You are a flyer up to 8,000 or 10,000 feet. Above that, *you* are a redesigned machine, one that will run smoothly and efficiently *if you follow the rules.* The trouble begins with the flyer who puts unnecessary stresses and strains on himself. You will have unlimited opportunity to put your endurance to the test against the enemy—don't waste that endurance through oxygen lack, inadequate protection against the cold, and pain in the belly.

BE SMART. FOLLOW THE RULES.
DON'T CHEAT YOURSELF.

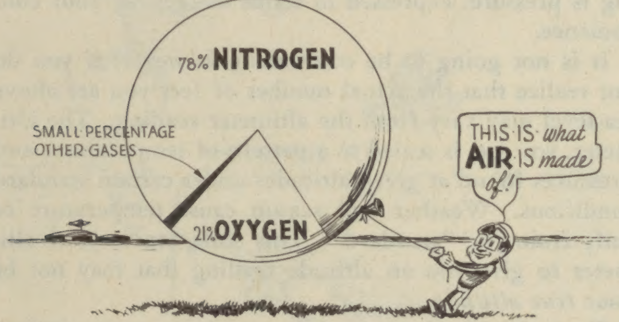


SECTION 1

YOU HAVE AN AIR ABOUT YOU

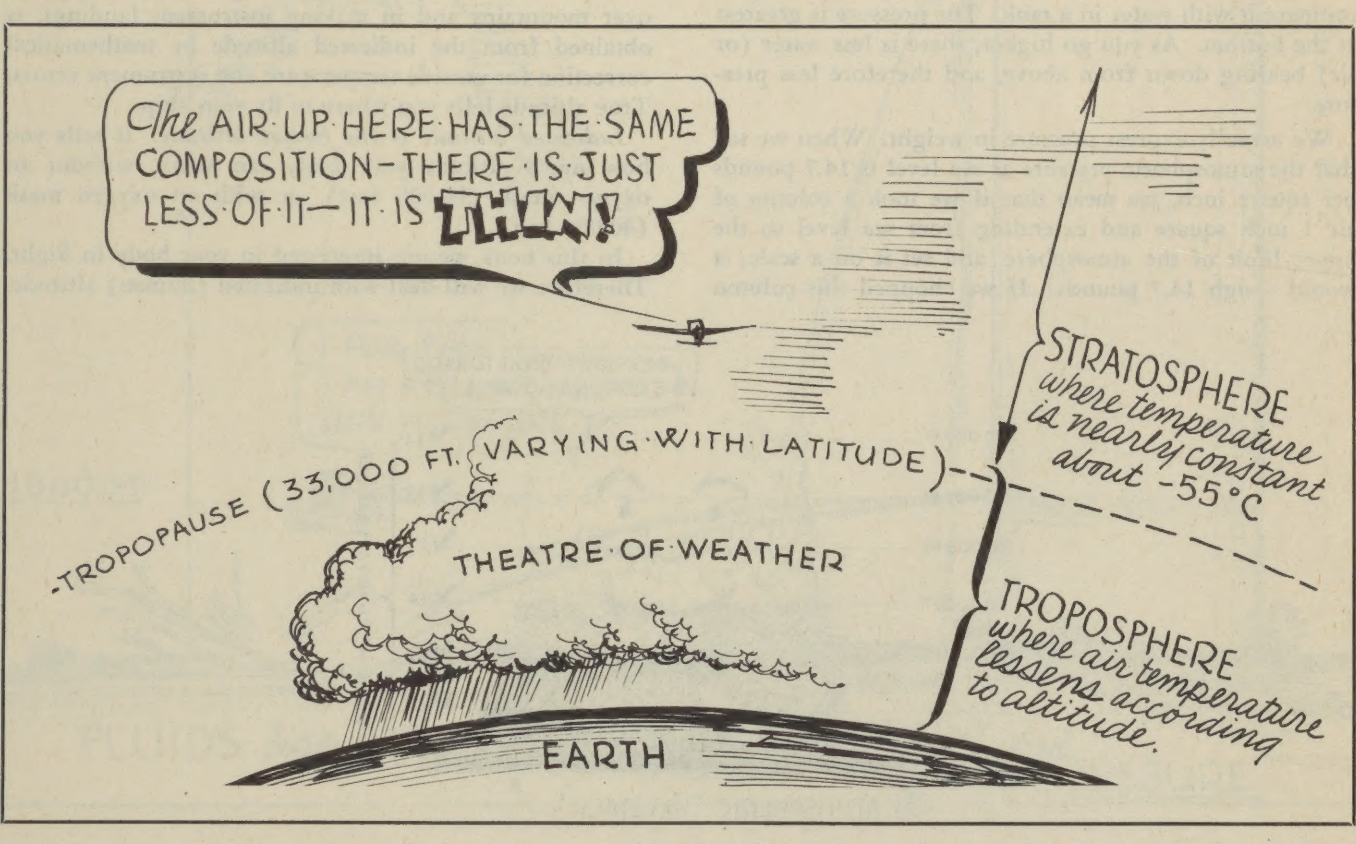
How the atmosphere affects you

THE EARTH IS COMPLETELY SURROUNDED by a covering of mixed gases and water vapor. This is known as the ATMOSPHERE, or air. It is more than 100 miles in depth, and is actually as much a part of our world as land and sea, being held to the earth's surface by gravity.



The mixture of gases in dry air is mainly nitrogen—78 per cent, and oxygen—21 per cent. The remaining 1 per cent consists of small amounts of miscellaneous gases, like carbon dioxide, hydrogen, helium, argon, and other rare gases. We speak of *dry* air to make things simpler. Actually, the atmosphere contains a variable amount of water vapor, (one to five percent) which reduces the proportions of nitrogen and oxygen to that extent.

The percentage composition of dry air does not change with altitude. The atmosphere contains the same proportion of oxygen at 50,000 feet as at sea level! At 50,000 feet the air is less compact, thinner, so there is a smaller amount (less weight) of air in a given space at 50,000 feet than there is in the same space at sea level. Therefore, even though the percentage of oxygen is the same at any altitude, the absolute amount in a given space becomes less and less as you go higher and higher.



The atmosphere changes in certain ways with increasing altitude. As you go higher, the atmosphere:

1. *Gets Less Dense.* It is the "thin" air which makes it harder for you to cough or talk at high altitude.

2. *Gets Colder.* This can cause a great deal of trouble unless you take steps to protect yourself. In general, the atmosphere gets 2° F colder for every thousand feet above sea-level, until you get to the stratosphere (about 33,000 feet), above which the temperature tends to remain constant at minus 67° F. This is only a general rule. Actually, temperatures of from minus 30° F to minus 60° F have been recorded at an altitude of 30,000 feet over Berlin. Any of these temperatures is enough to cause severe frost-bite unless you are properly protected.

3. *Has Less Pressure.* This change has the most important effects of all on the human being. It compels him to use oxygen equipment. If he is not careful and in good condition, it may cause him to have trouble with his ears, sinuses, or stomach. At very high altitudes, it may sometimes give him "bends."

The change in atmospheric pressure is so important in its effects on your body that you should know more about it.

What causes atmospheric pressure

The atmosphere is "piled" on the earth's surface like a haystack. The bottom layers are packed down more compactly, and therefore they are heavier than the layers near the top, where the "hay" is loose.

You can also understand atmospheric pressure if you compare it with water in a tank. The pressure is greatest at the bottom. As you go higher, there is less water (or air) bearing down from above, and therefore less pressure.

We actually express pressure in weight. When we say that the atmospheric pressure at sea level is 14.7 pounds per square inch, we mean that if we took a column of air 1 inch square and extending from sea level to the upper limit of the atmosphere, and set it on a scale, it would weigh 14.7 pounds! If we chopped this column off at 20,000 feet and put the upper part (from 20,000 feet up) on the scale, it would weigh only 6.75 pounds.

How you measure atmospheric pressure

On the ground, pressure is measured with a mercury barometer. In your airplane, pressure is measured by a gadget you know well—the altimeter, but do you know how it works? It is very simple. The altimeter contains a completely closed, hollow, metal disc from which air has been removed. Hence the pressure of the outside air compresses or flattens the disc. As you climb to altitude, this pressure gets less and less, and the spring tension of the disc causes it to expand like an accordian. As you come down from altitude, the outside pressure grows greater and pushes the sides of the disc inward or contracts it. The expansion and contraction of the disc operate a lever which turns the dials on the face of your altimeter. And you read the altitude in feet. But—

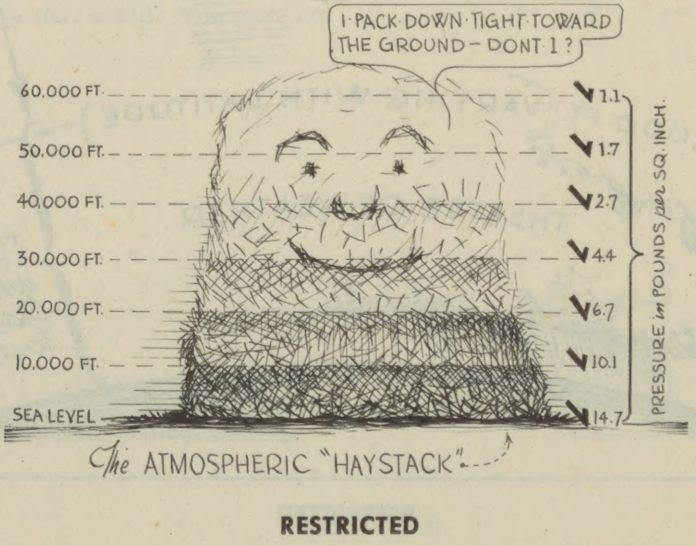
Is it actually feet? NO! What you are actually reading is pressure, expressed in terms of feet for your convenience.

It is not going to be convenient, however, if you do not realize that the actual number of feet you are above sea-level may vary from the altimeter reading. The altimeter, you see, is scaled to a pattern of temperatures and pressures found at given altitudes under certain standard conditions. Weather and season cause temperature to shift from the "standard." This shift causes your altimeter to give you an altitude reading that may not be your *true altitude.*

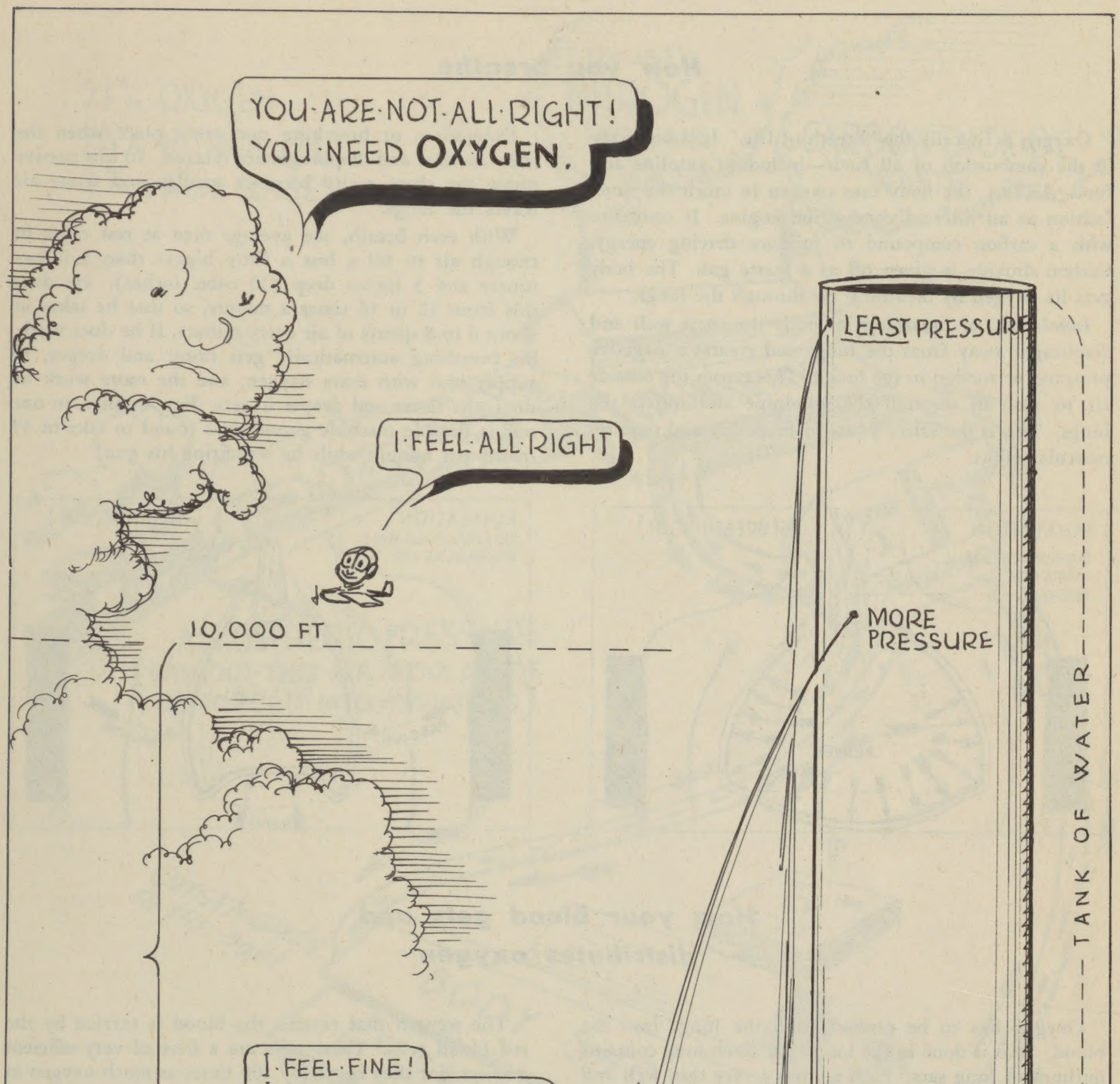
True altitude, important in navigating your airplane over mountains and in making instrument landings, is obtained from the indicated altitude by mathematical correction for outside temperature and instrument errors. True altitude tells you where to fly your ship.

Indicated altitude is the human altitude. It tells you how much altitude your body can stand, without an oxygen mask (10,000 feet), or with an oxygen mask (40,000 feet).

In this book we are interested in your body in flight. Therefore we will deal with indicated (human) altitude.



The ATMOSPHERIC "HAYSTACK"



FLUIDS *like* AIR *and* WATER·HAVE·WEIGHT *and* EXERT PRESSURE.

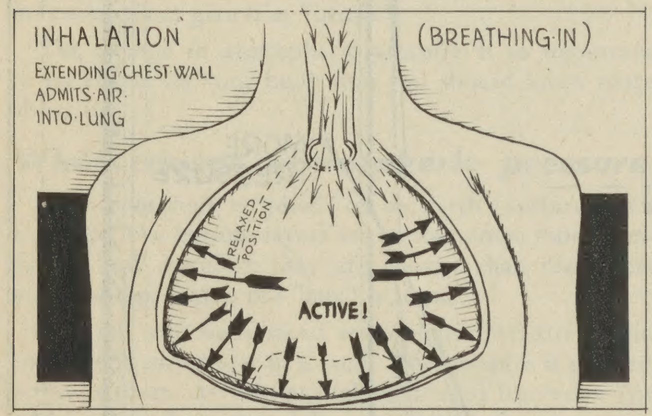
How you breathe

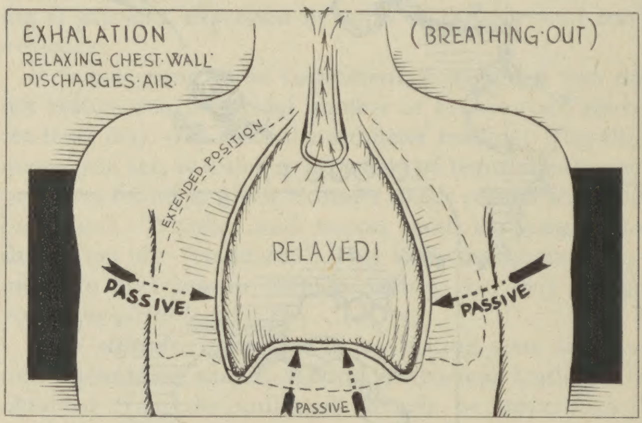
Oxygen is literally the "breath of life." It is necessary in the combustion of all fuels—including gasoline and food. In fact, the body uses oxygen in much the same fashion as an internal combustion engine. It combines with a carbon compound to produce driving energy. Carbon dioxide is given off as a waste gas. The body gets its oxygen by breathing air through the lungs.

Inhalation, or breathing in, pulls the chest wall and diaphragm away from the lungs and creates a negative pressure, or suction in the lungs. This causes the outside air to rush in through the windpipe and inflate the lungs. This is the *active phase* of breathing and requires muscular effort.

Exhalation, or breathing out, takes place when the chest muscles and diaphragm are relaxed. In this passive phase the chest cavity becomes smaller and waste air leaves the lungs.

With each breath, the average man at rest takes in enough air to fill a box a little bigger than 3 inches square and 3 inches deep (30 cubic inches). He does this from 12 to 16 times a minute, so that he takes in about 6 to 8 quarts of air every minute. If he does work, his breathing automatically gets faster and deeper, to supply him with extra oxygen, and the more work he does, the faster and deeper it gets. For instance, in one test, a flexible machine gunner was found to take in 47 quarts per minute while he was firing his gun!





How your blood gets and distributes oxygen

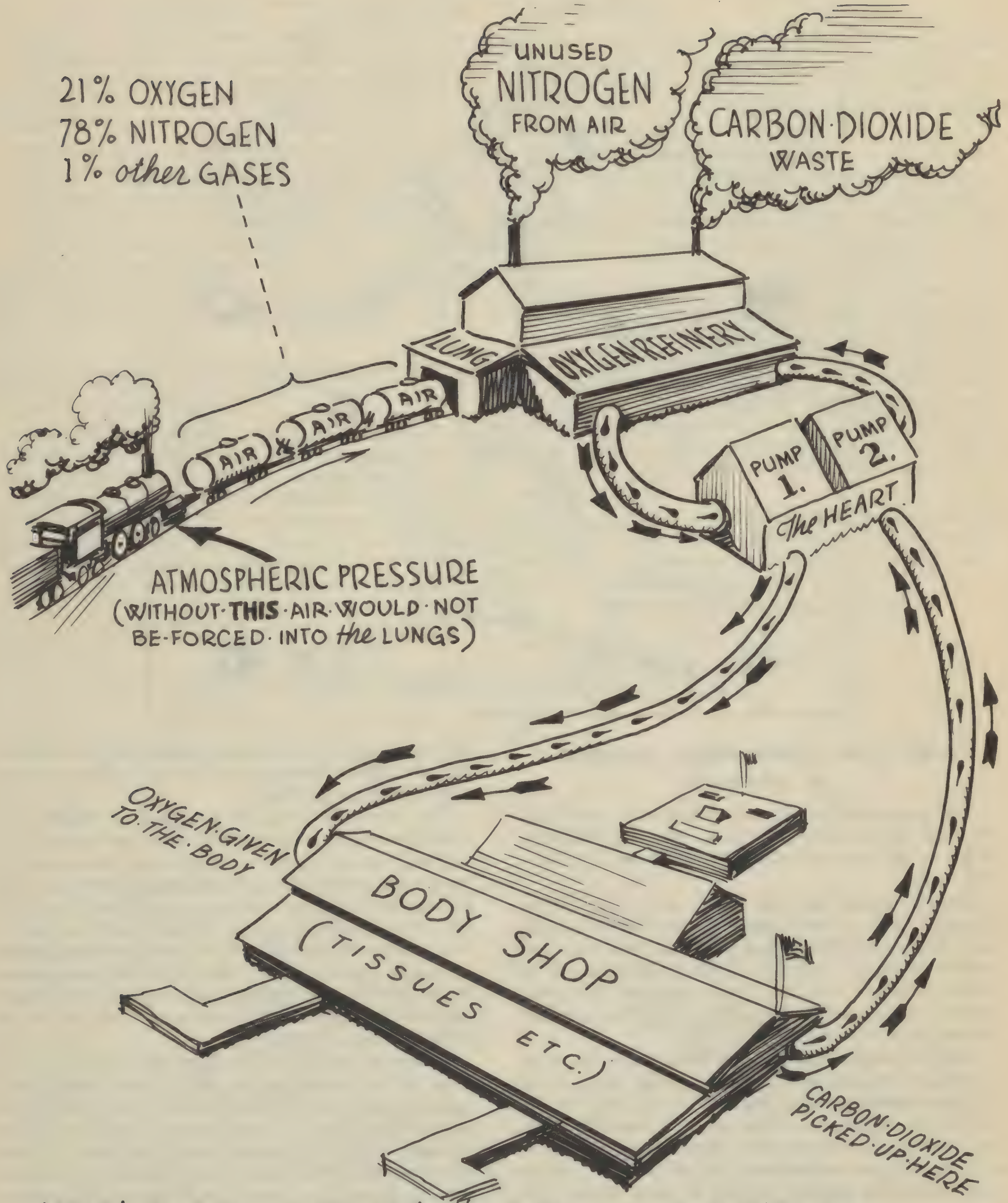
Oxygen has to be pushed from the lungs into the blood. This is done in the lung sacs. Each lung contains millions of lung sacs. Each sac has a very thin wall and is surrounded by a tiny blood vessel which also has a very thin wall.

These walls are so thin that any difference in pressure on either side will cause a gas to pass through. In this way, oxygen is pushed from the air in the small sac to the blood in the tiny vessel. Carbon dioxide, a body waste product, is pushed in the opposite direction, from the blood into the lung sac, and on out with your exhaled air.

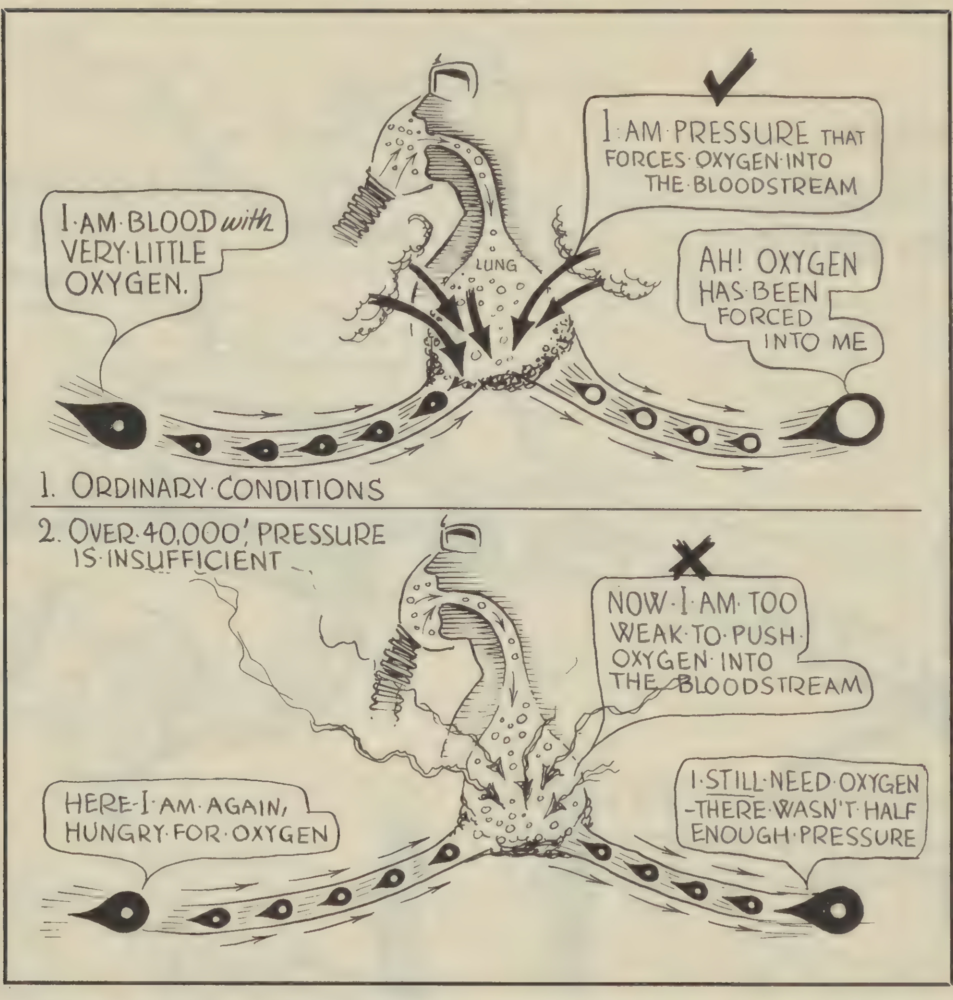
The blood is continually moving through the blood vessels, and you are continually breathing in and out, so the exchange of oxygen and carbon dioxide goes on all the time.

The oxygen that reaches the blood is carried by the red blood cells. These cells are a fleet of very efficient carriers, for they can carry 100 times as much oxygen as you can dissolve in water. They carry the oxygen to all the parts of the body, and every tissue gets the amount it needs. As it leaves oxygen with the tissues, the blood picks up the carbon dioxide (tissue waste) and carries it back to the lungs.

The entire process can be pictured in this way: The lungs serve as a supply depot and refinery for oxygen and a dump for carbon dioxide. The blood acts as a hydraulic conveyor system and is pumped around the body by the heart. The oxygen is pushed by the atmospheric pressure from the lungs into the blood, which carries it to the body tissues, where it burns food to produce energy.



HOW·BLOOD·SUPPLIES the BODY with OXYGEN by the BLOOD-TRANSPORTATION-SYSTEM.



Why you need extra oxygen at altitude

The oxygen in the air you breathe with your lungs wouldn't do you any good if it just stayed in the lungs. It has to get into your blood, which carries it all over your body.

Oxygen moves into the blood only because it is "pushed" in. It is under higher pressure in the lung air than in the lung blood—and you know that a gas will always go from a region of higher pressure to one of lower pressure. It is the *oxygen pressure,* then, that makes oxygen available to your blood, and so to all the distant parts of your body.

Oxygen pressure makes up the same proportion of atmospheric pressure as oxygen percentage does of air. Oxygen makes up about one-fifth (21 percent) of the air—at all altitudes, so it also makes up one-fifth of the air pressure—at all altitudes. Atmospheric pressure is 14.7 pounds per square inch (psi) at sea level. At sea level, then, the oxygen pressure is about 3 psi. This pressure is enough to push all the oxygen you need into your blood. At 18,000 feet, though, atmospheric pressure is 7.33 psi (only half of what it is at sea level) so the oxygen pressure is only 1.5 psi—*not* enough to push sufficient oxygen from the lung air into your blood. The higher you go and the less the atmospheric pressure, the less the oxygen pressure, and *the less oxygen you actually get into your blood.*

That is why you need extra oxygen at altitude—because the oxygen pressure in the air is not enough.

If you were to breathe air that is *more* than one-fifth oxygen, say one-half oxygen, the oxygen pressure would be *half* the atmospheric pressure. At 18,000 feet with this arrangement the oxygen pressure would be half of 7.33 psi (atmospheric pressure)—enough to force plenty of oxygen into the blood. That is just the arrangement you have with your oxygen mask. It gives you a richer mixture of oxygen in the air you breathe and so you get a higher oxygen pressure.

As you will see when you read about oxygen equipment in this book, the demand oxygen system automatically gives you as rich a mixture of oxygen with air as you need—at any altitude up to 40,000 feet. It increases the oxygen percentage enough *to give it the necessary pressure.* The higher you go, the richer the mixture, so the *oxygen pressure stays the same as it would be on the ground.* At 34,000 feet you need—and get—100 percent oxygen, which keeps you at ground level conditions. You can go even higher than that with an oxygen mask, though, just as you can go to 10,000 feet without a mask.

BUT THIS CAN'T GO ON. When you go above 40,000 feet, even 100 percent oxygen can't give you enough pressure for safety—because there is so little pressure in the atmosphere that even the *total atmospheric pressure* can't force enough oxygen into your blood!

Does this stop you from going above 40,000 feet? Not if you can increase the pressure in some other way.

You can do this—with a pressure cabin or a pressure mask, about which you will learn later in this book.

While we're talking about oxygen, let's knock a few screwball ideas for a loop: Oxygen does *not* damage your lungs. Oxygen does *not* damage your teeth. Oxygen is *not* habit forming. The moon is not made of cheese.

Why faster breathing doesn't help

Don't *force* your breathing!

A few fliers occasionally make the serious mistake of thinking that a quick way of getting more oxygen at high altitudes is to breathe faster. It is true that this will get more oxygen into the blood, but it will also *knock you out* if you keep it up. Curiously enough, this is due to the fact that carbon dioxide is eliminated too rapidly. You would think there was no harm in eliminating this gas, since it's a waste product. There isn't, unless you do it too fast.

HERE'S WHY:

The rate of your breathing is regulated automatically by how much carbon dioxide is in your blood. The depth and speed of breathing increases as the blood's load of carbon dioxide increases, and decreases as the load decreases.

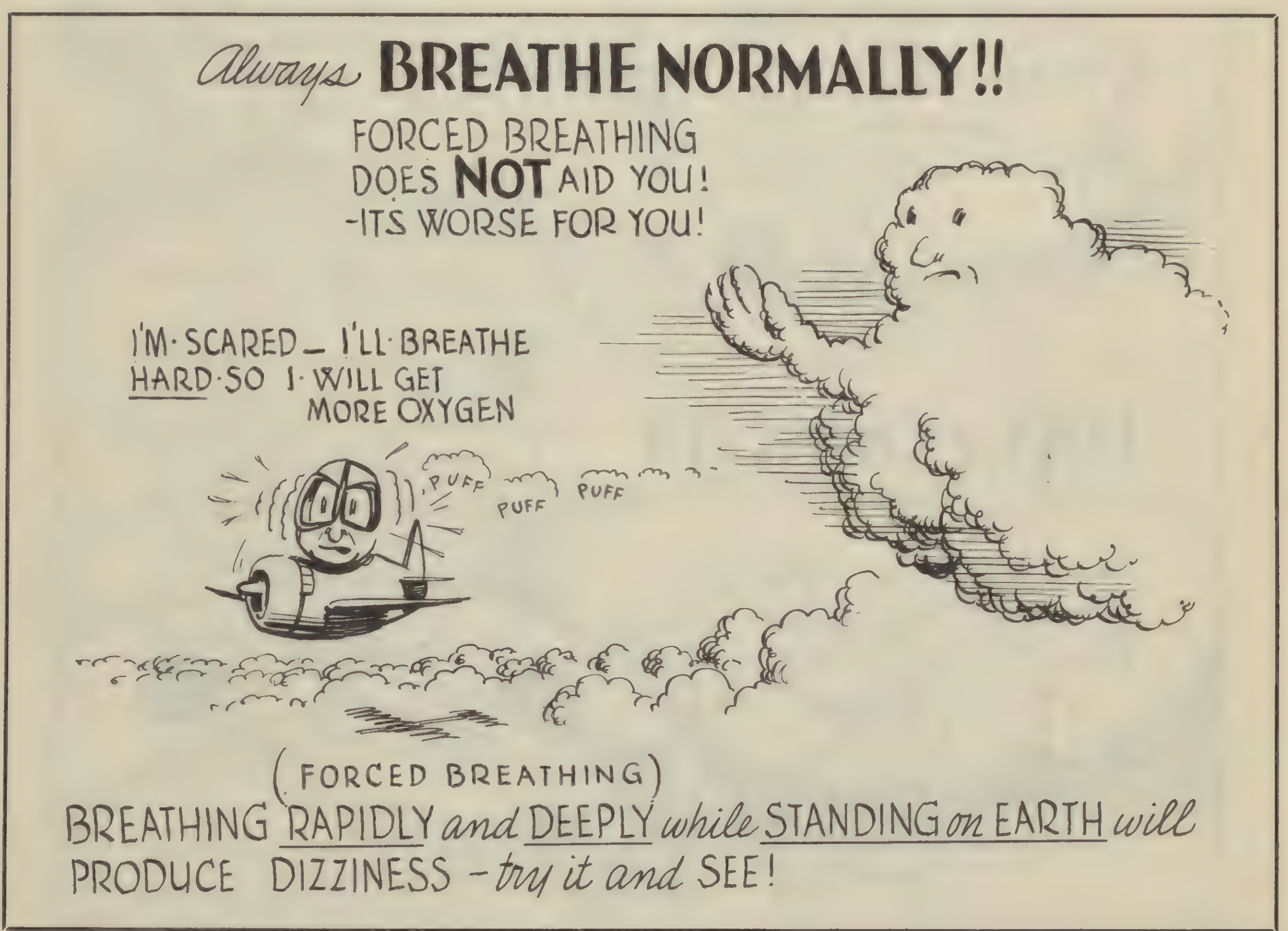
This is as it should be. When you're on the ground, your need for oxygen depends on how much work you're doing. When you run around the block, you breathe faster without thinking about it. The carbon dioxide which accumulates in your blood does your thinking for you.

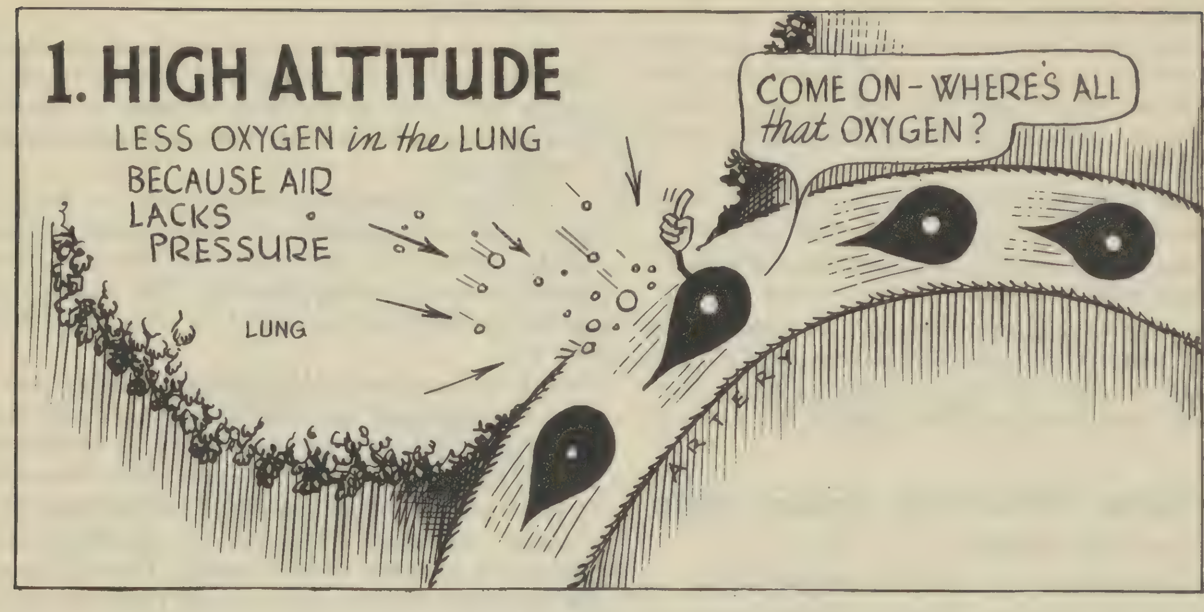
It is the same at altitudes, because, wearing your oxygen mask, you are, as far as oxygen goes, still "on the ground." Therefore you never have to breathe faster unless extra work requires it—and under those circumstances, carbon dioxide regulates your breathing for you.

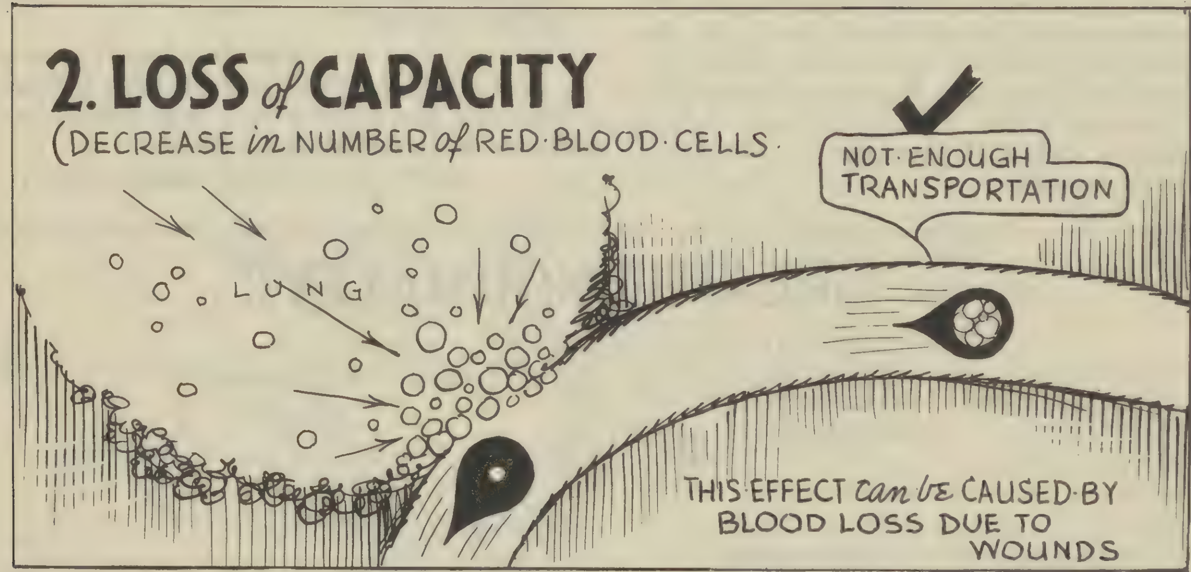
Don't overbreathe! If you do it long enough you will get rid of too much carbon dioxide. This will cause you to get dizzy and develop spots in front of your eyes; your fingers and toes will get numb and eventually they may get paralyzed.

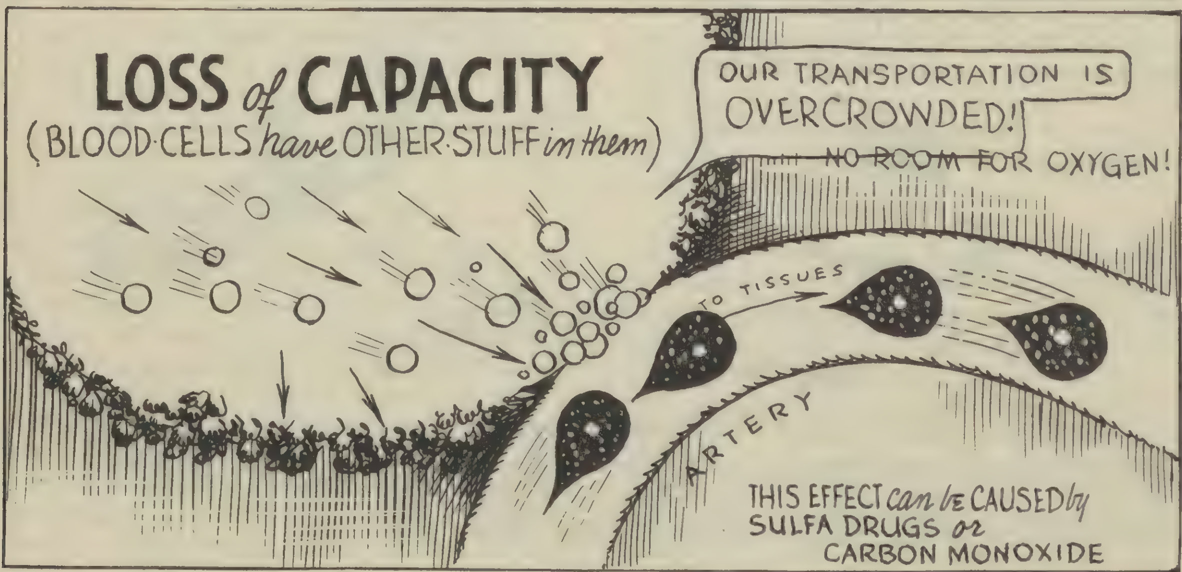
You may tend to overbreathe *especially when you are excited or scared.* Watch your breathing at those times. Other than that, forget about your breathing—let carbon dioxide do your thinking for you!

DON'T DO FORCED BREATHING!




1. HIGH ALTITUDE
LESS OXYGEN in the LUNG
BECAUSE AIR LACKS PRESSURE
LUNG
COME ON–WHERE'S ALL that OXYGEN?
ARTERY


2. LOSS of CAPACITY
(DECREASE in NUMBER of RED·BLOOD·CELLS
LUNG
NOT·ENOUGH TRANSPORTATION
THIS·EFFECT can be CAUSED·BY BLOOD LOSS DUE TO WOUNDS


LOSS of CAPACITY
(BLOOD·CELLS have OTHER·STUFF in them)
OUR TRANSPORTATION IS OVERCROWDED!
NO ROOM FOR OXYGEN!
TO TISSUES
ARTERY
THIS EFFECT can be CAUSED by SULFA DRUGS or CARBON MONOXIDE

What causes oxygen lack

Being at altitude without adequate oxygen is the most important cause of oxygen lack in fliers, but there *are* other causes. Altogether, there are *four* types of oxygen lack which may affect the flier:

1. *High Altitude.* This, as you have learned, is due to insufficient oxygen pressure in the lung.

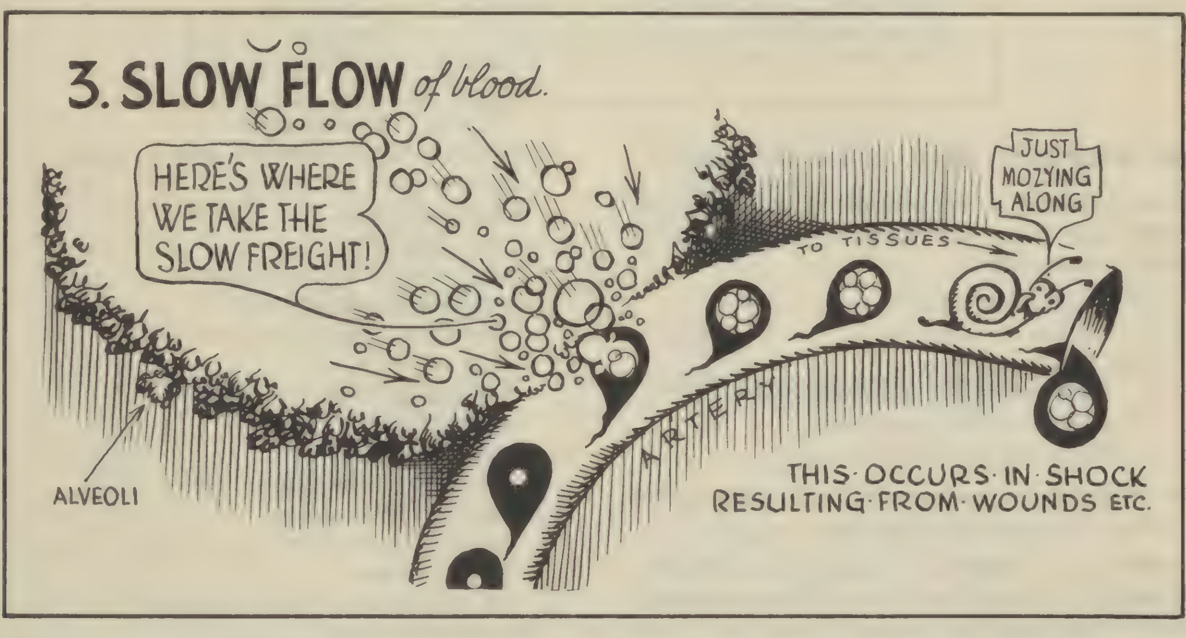
2. *Reduced Oxygen-Carrying Power of the Blood.* No matter how much oxygen pressure you have in your lungs, it doesn't do you any good unless the oxygen can be carried by the blood to the tissues. A loss of the blood's carrying power can come about in two ways:

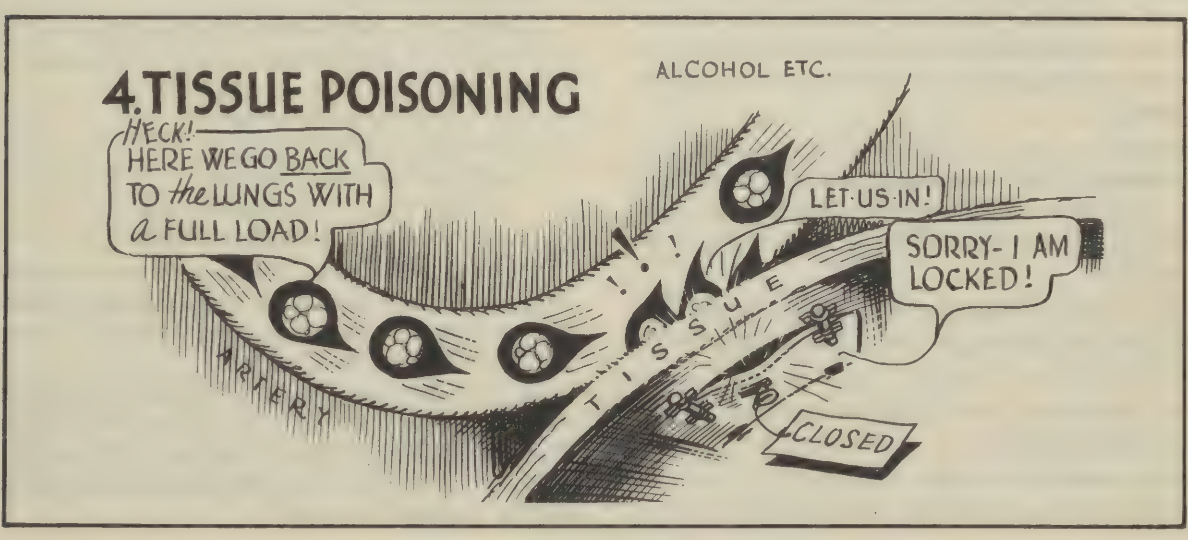
Wounds may cause a loss of blood, so that there is less blood and therefore too few red blood cells to carry the required oxygen.

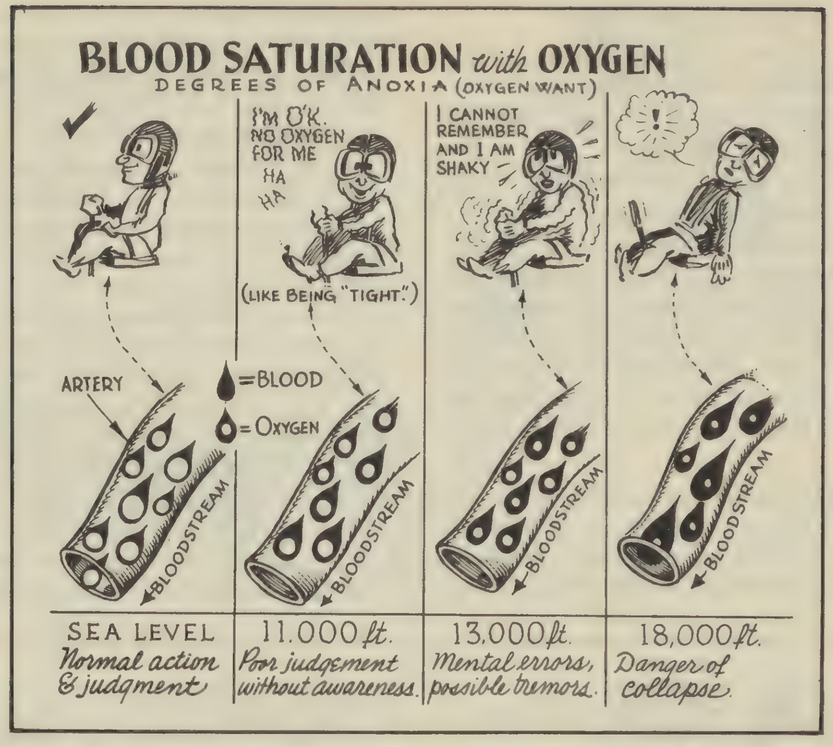
Certain chemicals, like the carbon monoxide in exhaust gas, or the sulfa drugs you take for infections, can grab off the space in red blood cells that is ordinarily reserved for oxygen. *Carbon monoxide* is especially dangerous, because the red blood cells take it up 200 times more readily than they do oxygen; and whereas oxygen will leave a red cell without too much fuss, carbon monoxide clings to the red cells stubbornly.

3. *Slow Flow of Blood.* Good supply involves not only the amount of material but also the speed with which the material is delivered. The tissues do not profit from oxygen in the blood unless the oxygen is brought in fast enough to supply tissue needs. The condition of shock resulting from wounds (injury or loss of blood or both) causes the blood pressure to drop and the blood flow to slow down. Oxygen isn't brought to the tissues fast enough. *This, too, is oxygen lack.* Shock calls for the continuous administration of oxygen, no matter what the altitude.

4. *Tissue Poisoning.* A well-filled, fast-running supply train is useless if it can't be unloaded when it arrives at its destination. Chemicals like alcohol block up the tissues, so that the oxygen brought in by the blood is "locked out" and can't be unloaded.







How oxygen lack affects you

When the pressure is insufficient to force enough oxygen from your lungs into your blood, you develop symptoms of oxygen lack.

The higher the altitude,
The less the pressure.
The less the pressure,
The less oxygen in your blood.
The less oxygen in your blood,
The worse the effects on *you.*

And the longer the time over which this goes on, the more the effects of oxygen lack increase.

These effects are insidious, if you don't recognize them; for either they creep up on you without warning, *or* they begin by making you feel good—and that's even worse! A flier suffering from oxygen lack may feel exhilarated (as though he's had a couple of highballs) at a time when his judgment, coordination, and memory are very faulty.

This combination of overconfidence and poor judgment — frequent with oxygen lack — is DYNAMITE. Every flier who feels too pleased with himself at altitude should think of the possibility that he is suffering from want of oxygen.

Although it varies somewhat with different individuals, the effects of oxygen lack may be summarized in general as follows:

At 8,000 to 10,000 feet (more than four hours):
fatigue, sluggishness

At 10,000 to 15,000 (two hours or less):
fatigue, drowsiness, headache, poor judgment

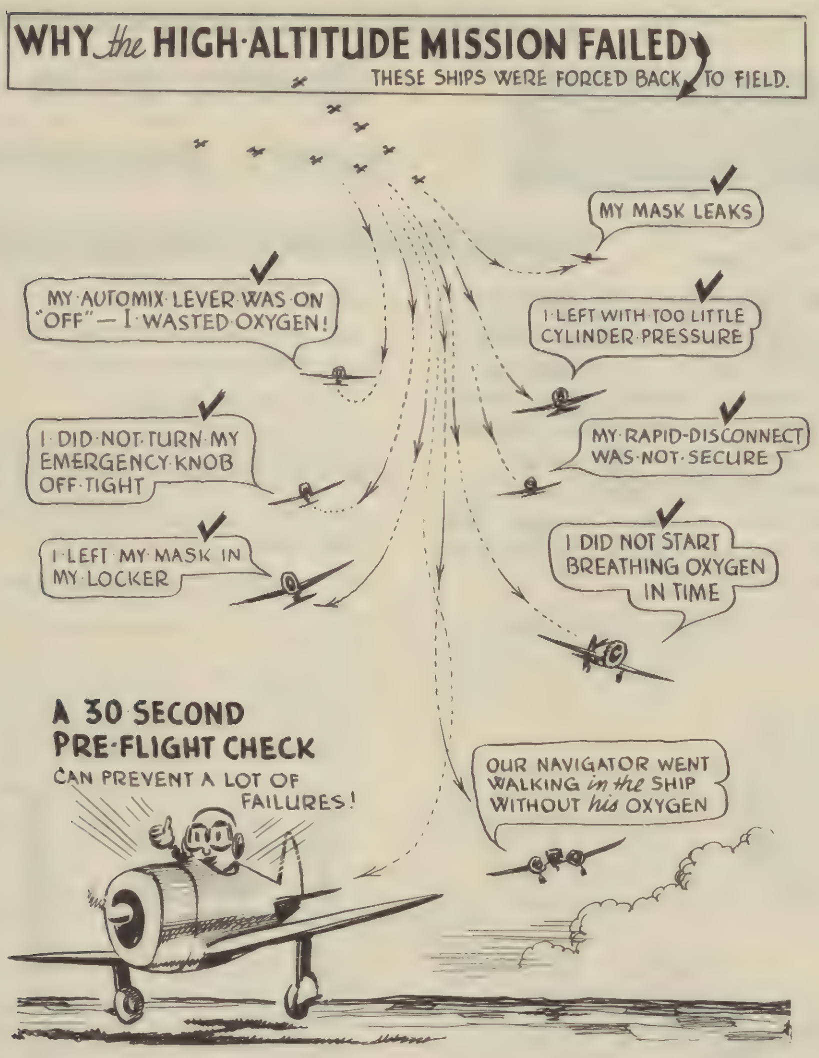
At 15,000 to 18,000 feet (½ hour or less):
false sense of well-being
overconfidence
poor judgment
narrowing of field of attention
unsteady muscle control
blurring of vision
poor memory
faulty reasoning
may pass out

Over 18,000 feet:
above symptoms come on faster
loss of muscle control
loss of judgment
loss of memory
loss of ability to think things out
no sense of time
purposeless movements, repeated again and again
emotional outbursts, like fits of laughing and crying

Loss of consciousness generally occurs:
at 26,000 feet in 4-6 minutes
at 28,000 feet in 2-4 minutes
at 30,000 feet in 1-2 minutes
at 35,000 feet in 50 seconds or less
at 38,000 feet in 30 seconds or less

Remember that these time figures vary with the individual and with the "work" he is doing. Death from oxygen lack has occurred in as little as 3 minutes at 23,000 feet in combat.

One of the most important effects of oxygen lack is the reduction it causes in night vision. Poor night vision is the *first* effect of want of oxygen. That is the reason all fliers use oxygen from the ground up on tactical and combat missions at night.



Why missions fail

Ninety-nine percent of oxygen accidents and the aborted missions they cause are due to ignorance or carelessness.

THERE IS NO EXCUSE FOR EITHER! Let's get down to cases. Here is a quick summary of reasons for oxygen lack at altitude. Read 'em, but *don't* weep—they can be avoided, if you do preflight checks.

1. Oxygen system not filled to capacity (425 psi).
2. Oxygen supply exhausted by leaks.
3. Oxygen supply used up too soon by improper use of emergency knob or auto-mix.
4. Mask leak due to:
   a. Poor fit.
   b. Improper seating of exhalation flutter valve.
   c. Holes in mask or mask hose.
   d. Cheek flaps not under helmet.
   e. Loose fit of "mike" wire entering mask.
5. Leaks around quick-disconnect assembly (between mask hose and regulator hose) due to:
   a. Warping of metal end of mask hose.
   b. Absence of rubber gasket at end of mask hose.
   c. Separation of insecure disconnect.
6. Defects in regulator due to:
   a. Loose connection of hose to regulator.
   b. Tear in rubber diaphragm in regulator.
   c. Openings in regulator blocked.
7. Blocked supply lines due to freezing of moisture in oxygen system at extremely low temperatures.

The proper functioning of your oxygen equipment depends on YOU. You must preflight check your oxygen equipment—*before every mission.* That is your job.

But you have help, very capable help if you need it. Your Personal Equipment Officer is a specially trained expert in oxygen equipment. He will assist you in many ways—like checking your mask fit with special apparatus, fitting and refitting your mask, and seeing that necessary repairs and replacements are made in your oxygen equipment.

He's a valuable man, your Personal Equipment Officer, but you can't take him along on your missions—so *you* have to know your oxygen equipment.

SECTION 2

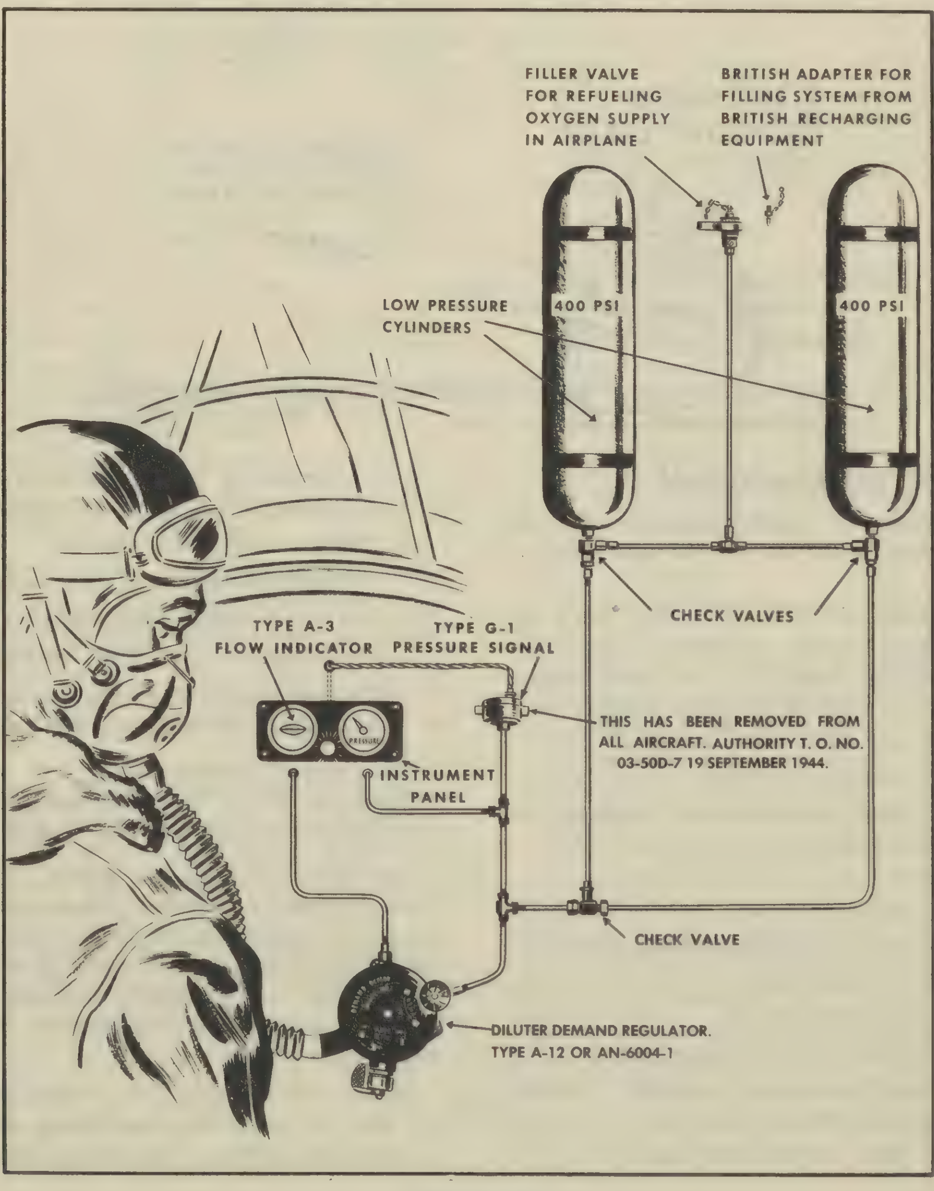
GOING UP IN THE RIGHT ATMOSPHERE

The demand oxygen system

The Demand Oxygen System in your ship insures a fully adequate supply of oxygen at all altitudes up to 40,000 feet. It was designed to provide you, automatically, with as much oxygen as you need when you need it—for all altitudes and varying degrees of activity.

THERE IS ONLY ONE "CATCH"! You must preflight check your equipment to assure yourself that everything is in proper working order! The Demand Oxygen System is made up of:

1. Demand mask.
2. Mask hose and regulator hose joined together by a quick-disconnect assembly.
3. Demand regulator.
4. A panel consisting of a flow indicator (blinker or bouncing ball) and a pressure gage.
5. Filler and distribution lines, check valves, and filler valve.
6. Cylinders containing *aviator's breathing* oxygen.



The demand mask

TYPES. The A-10 Revised is being replaced by the A-14. The A-10A will remain in use, for it is very similar to the A-14. Improved features in newer demand masks (A-10A and A-14) include: two-point suspension to winter or summer helmet; easier to fit; more comfortable; better visibility.

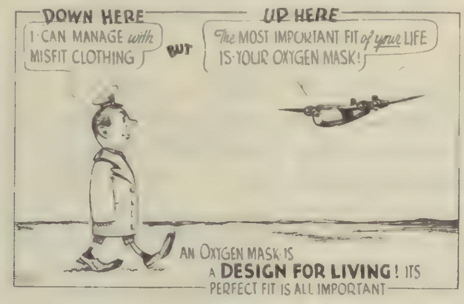
SUSPENSION. The A-14 mask is suspended directly from the winter or summer helmet:

On the left side: by studs and buckle-tabs. Studs must be placed individually for each flier in order to get a leak-proof mask fit. Stud suspension is generally best left attached.

On the right side: by a hook. Use this hook to take the mask away from your face as desired. Pull hook up to take off. Proficiency in operating the hook with your glove on may be achieved by practicing hooking and un-hooking in front of a mirror.

FITTING MASK TO FACE. This is the most important fit of your life.

The mask must be individually fitted for each flier, and the fit must be regularly checked. The original fit must be done by the Personal Equipment Officer or Flight Surgeon.



Important Points Concerning Fitting

1. Mask must fit on the (bony) bridge of the nose. Don't fit it low down on the fleshy part of the nose where it will obstruct the nasal passages. You might just as well have a clothes pin clamped on your nose! If seal is below bony part of nose, try next larger size of mask.

2. The nose-wire is "built-in," should be adjusted as required only by an experienced mask-fitter.

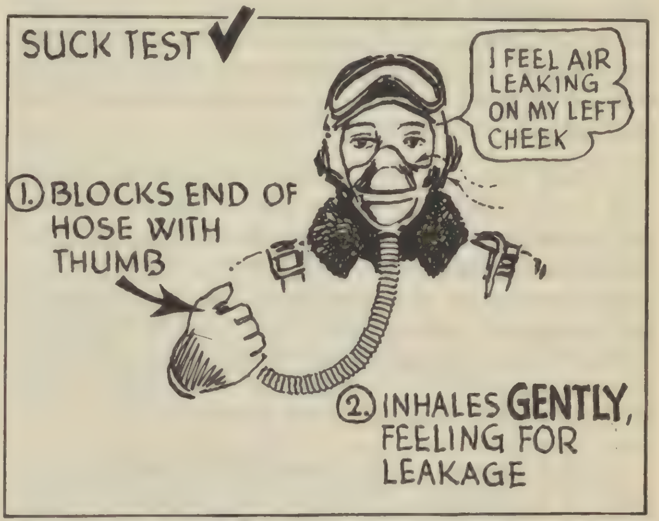
3. Don't have upper edge of mask too tight on your face, especially along your cheek-bones. Undue pressure may more easily cause frost-bite in the low temperatures encountered at altitude.

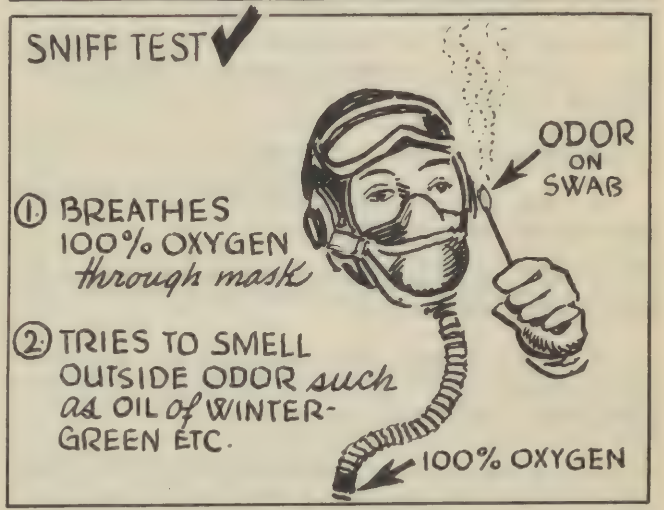
4. If mask digs into your face or interferes with vision, the upper edge may be trimmed, but only by an experienced mask-fitter. Let your personal equipment officer be the "surgeon" who does the operating.

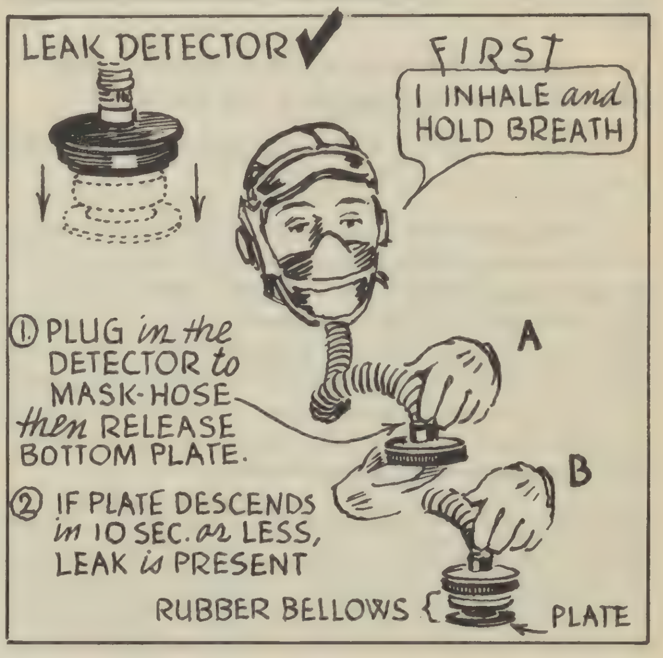
5. Cheek flaps *must* fit under helmet. If not, you will have a bad leak.

6. Excessive beard stubble may cause mask to leak in region of jaws.

7. To correct mask leak, first try proper lengthening or shortening of suspension straps. This generally does the trick. If it doesn't, built-in nose-wire may need adjustment; this should be done only by an experienced mask-fitter!







HOW TO TEST YOUR MASK FOR LEAKS.

1. *Suction Test:* Not sensitive, but adequate for preflight check if done properly. Close off end of mask hose completely with your thumb and inhale *gently.* (Don't get passionate. Violent inhalation will make any mask *seem* to fit.) Marked resistance to inhalation means no leak. Less resistance, or air coming in alongside nose or cheeks means the mask leaks.

2. *Sniff Test:* A very sensitive test which requires only a swab-stick with cotton and a pungent-smelling oil. A permanent sniff-tester may be made by filling an empty nasal inhaler tube with cotton soaked in oil of wintergreen or oil of peppermint. The mask is hooked up to regulator with automix "OFF" ("100 PERCENT OXYGEN"), and swab dipped in the oil or sniff tester is run along right near upper edge of the mask. If the oil is detected by smell, the mask leaks.

3. *Leak Detector:* The Demand Mask Leak Detector, which is 3½ inches in diameter and easily fits into your pocket, is a quick, effective way of testing for mask leaks. It can even be used in the airplane. It consists of a top plate attached by a rubber bellows to a bottom plate. You use it as follows:

a. Inhale and hold your breath.

b. Plug your mask hose into the top plate while you hold the plates together.

c. Now, continuing to hold your breath, release the bottom plate and watch it.

d. If the bottom plate comes all the way down (1-1/2 inches) in 10 seconds or less, you have a dangerous mask leak. Refit and retest.

e. If the bottom plate does not come down all the way in 10 seconds, you have a mask leak of less than 5 percent. This is satisfactory.

f. If the bottom plate does not come down at all in more than 10 seconds, you have a very fine mask fit.

Don't try to "fix" a broken leak detector or one that is out of order. Get a new one!

4. *Scholander Test:* Involves special chemical analysis of contents of air drawn from mask. This test, done by the Personal Equipment Officer, is the "last word." Mask fit must be repeatedly checked for leaks. Your mask is *not* a cast-iron mold. It changes shape, the straps lose tension, etc. You can tell when the fit needs changing only by testing for leaks. Test for leak as a regular preflight check. *In addition—Have mask tested by Personal Equipment Officer periodically.*

TAKE CARE OF YOUR MASK. Your life at altitude depends on your mask. Keep it in a special sack, bag, or box, and in a regular place. Be careful of the way it is kept for the mask may be pressed out of shape. *Wipe it dry after every use.* Keep the exhaust flutter valve clean — frozen mucus may prevent it from working properly.

Do not lend or borrow a mask except in case of emergency! After every 5 to 10 hours of use

1. Clean inside of mask with tepid water and mild soap. Rinse well to get rid of all soap. Cover the mask mike to keep it dry while washing the mask. Pat, do not rub the mask dry. Hang it up to dry completely—but keep it away from sunlight and heat, which deteriorate the rubber. You LIVE in that mask at altitude. Accumulated mucus from the nose, perspiration from the face, etc., can make it an extremely unpleasant residence. Keep it clean!

2. Inspect carefully for leaks, cracks, or holes in the face-piece and the hose.

3. Have fit checked by Personal Equipment Officer or Flight Surgeon.

4. Check entrance of "mike" wire in nipple on front of mask to be sure wire fits tightly.

FREEZING OF THE MASK AT ALTITUDE. Freezing is less of a hazard with the demand mask (A-10A and A-14) than with the old continuous-flow mask (A-8B). But the A-10A and A-14 may freeze and not work at altitude unless you take precautions to prevent it.

The "Danger Zones" of the A-10A and A-14 are the inhalation ports on the inside of the mask where accumulated moisture may freeze and block the oxygen inlets. Rubber flaps have been devised to raise the inhalation ports and prevent the accumulation of moisture. They can be installed easily by your Personal Equipment Officer.

To break up any ice forming on the front of the mask at high altitude, squeeze the mask two or three times. Repeat as necessary.

HOW TO REMOVE THE MASK AT ALTITUDE. You've been wearing your mask for a couple of hours—your nose is obstructed by mucus—or a nasal secretion is leaking down your face and into your mask—your face is irritated with perspiration under the wet mask—you want to blow your nose, or wipe your face, or perhaps drain the mask of moisture—but you are at 30,000 feet, and if you just take the mask off and "trust to luck," you may pass out before you get it on again.

But there is a technique for removing the mask at altitude, and it is fool-proof, if done correctly. Here's the technique:

1. Unhook mask on right side but hold it tight against the face.

2. Take three or four deep breaths.

3. Hold breath and drop mask.

4. Wipe out mask, etc.—Don't breathe outside air.

5. Replace mask and start to breathe.

6. After you have "caught up," with the mask on your face, the procedure may be repeated.

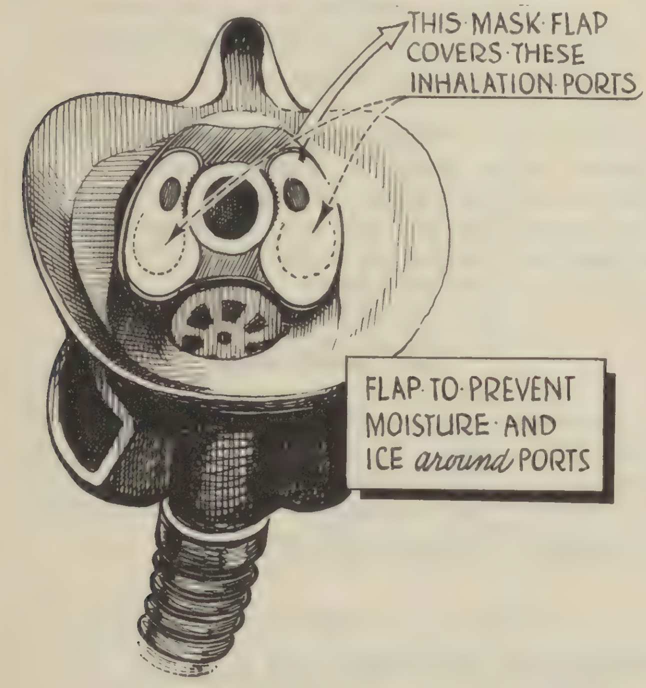
CAUTION: This may be done repeatedly, but DON'T hold breath longer than is comfortable. DON'T BREATHE OUTSIDE AIR. In case of any doubt or difficulty, crack the emergency knob while mask is off the face.

Never remove the mask unless you can devote all your attention to it!!

Never remove mask when your face would be exposed to a cold wind. (Frost-bite!)

Never remove your glove to unhook mask at altitude. (Practice with glove on in front of mirror.)

Never remove mask above 20,000 feet unless you use the prescribed technique.



Quick-disconnect assembly

(Connection between mask hose and regulator hose)

Improper use of the disconnect has cost lives! The connection is actually a very safe one, *if you use it properly.*

IS THE RUBBER GASKET IN PLACE? An air-tight seal at the disconnect is impossible without the rubber gasket. Absence of the gasket will cause mental and physical inefficiency at 24,000 feet. At 28,000 feet you will become "slap-happy" and will pass out.

IS THE QUICK DISCONNECT TIGHT? It must be secure enough to be separated by a pull of not less than 12 pounds. Plug in tightly—all the way. Inspect metal end of mask hose for warping—warping will cause a leak, or weak connection, or both.

USE THE CLOTHES CLIP ON THE FEMALE END.

Why—Connection is dangerous without the clip. Clip takes tension off the connection—such tension may pull the mask down on your face when you turn or raise your head—it may even separate the connection. *In combat,* this would not attract your attention. You'd pass out without warning.

How—Attach clip to parachute harness or special canvas strip sewn to flying jacket. Attach clip at proper level to give enough slack in mask hose to allow all head movements without tension on connection—but not too much slack, for that may cause hose to kink.

NOTE: If you ever suddenly can't breathe through the mask, don't get panicky. Your hose may be kinked. Remove clip, undo kink, and replace clip properly.

SPECIAL INFORMATION ON QUICK-DISCONNECT.

1. Drawing (ASC44A1325) is available for local manufacture of new instrument for quick repair of metal end of mask hose. Your Personal Equipment Officer will take care of this for you.

2. A new metal end has been provided which makes for a somewhat stronger connection. It *looks* a little *different* from the standard type, but both types *work* in the same *way.*

3. A locking device (AAF Drawing No. 44A26409) is available, which fits on the female part of the disconnect assembly. When you connect your mask hose, this lock prevents the male disconnect from pulling out accidentally.

Connection of regulator hose to regulator

TWO SIMPLE FACTS.

1. *Outlet elbow* must not be a loose swivel joint. If you can turn it, tighten the black, knurled collar until it is immovable. *Why?* If it can be moved, there will be a leak. Like many other possible leaks in the oxygen system, this may be insignificant at lower altitudes, BUT falling atmospheric pressure increases leaks! Leaks from this source have caused crewmen in combat to become groggy and in some cases unconscious.

2. *Hose connection* must be wired on to outlet elbow of regulator to prevent it from slipping off. (Revised regulators have fluted elbow joints, therefore better connection. But original regulators are *fine* if you watch those two points. New-type regulator hose is more flexible, has more "stretch," better withstands cold.)

Diluter-demand regulator

The diluter-demand regulator is so named because (1) it mixes (dilutes) oxygen with air wherever it is safe to do so and thereby saves oxygen, and (2) it supplies oxygen on "demand." Regulator is a diaphragm-operated flow-valve, which opens when you breathe in and lets oxygen flow, and automatically closes when you stop breathing in. Gives you as much oxygen as you ask for. All you do is breathe. Short breath draws short whiff of oxygen. Deep, rapid breathing brings large whiffs of oxygen in rapid succession.

BREATHE NATURALLY. Don't do forced breathing. Extra work *automatically* makes you breathe harder. Let your body, not your mind control your breathing.

TYPES. Don't be confused by the four different types of diluter-demand regulator. They all *look* a little *different*, but *you operate* them all the *same* way.

Name	*How to identify*
Airco A-12 Original	*Round-top* emergency knob luminous *lines* on auto-mix lever
Pioneer A-12 Original	*Round-top* emergency knob luminous *circle* on auto-mix lever
Aro AN 6004-1 Revised	*Flat-top* emergency knob luminous *lines* on lever
Pioneer AN 6004-1 Revised	*Flat-top* emergency knob luminous *circle* on lever

NOTES FOR USE OF ORIGINAL TYPES.

1. Auto-mix "ON" is "NORMAL OXYGEN."
2. Auto-mix "OFF" is "100% OXYGEN."
3. Do not open emergency wide—just barely cracking it will give you all the oxygen you need or can use.
4. Never tamper with set-screws of Aro regulator, or you will change the entire setting of the regulator.

CHANGES IN BOTH REVISED TYPES.

1. Fluted elbow adapter prevents loosening.
2. Higher oxygen flow rates.
3. Much less suction needed to get oxygen "on demand."
4. Air cut-off (100% oxygen) at 34,000 instead of 30,000 feet.
5. Emergency knob has flat top; emergency flow is only 40 percent as much as with original types; and emergency flow is the same whether you just "crack" the valve or open it wide.
6. New auto-mix labels:

   "NORMAL OXYGEN" instead of "ON"

   "100% OXYGEN" instead of "OFF"

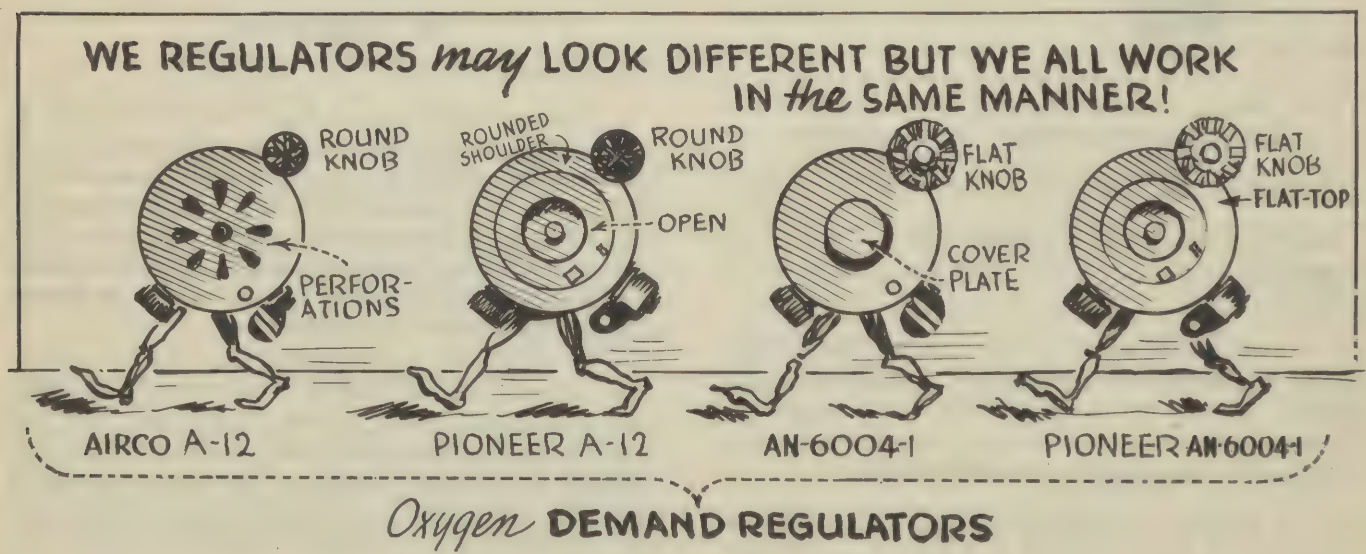
CHANGES IN ARO REVISED TYPE ONLY.

1. Holes in front plate which exposed diaphragm in original type now covered by slightly elevated disc.
2. Locking wires on set-screws.

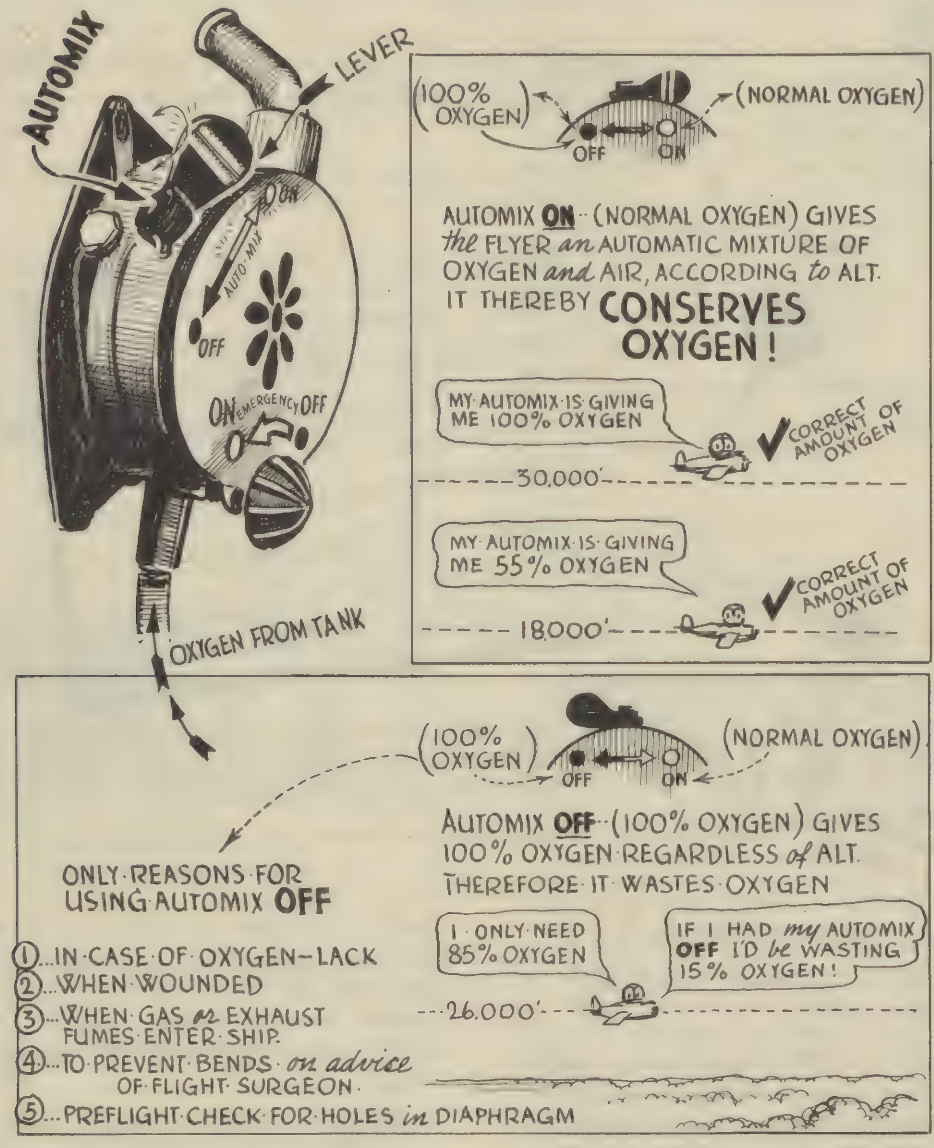
CHANGE IN PIONEER REVISED TYPE ONLY. Sharply angled instead of rounded shoulder on outer rim of cover. *Remember:* The regulators look different, but you use them the same way. The original types are as good as the revised types—both types give you all the oxygen you need "on demand."

The auto-mix

Regulator can be set to conserve oxygen or to give you 100% oxygen. This is governed by the position of the auto-mix lever — auto-mix "ON" is "NORMAL OXYGEN." But in either case you have to breathe to get oxygen—you get it only "on demand."



HOW TO USE the AUTOMIX



AUTO-MIX "ON" ("NORMAL OXYGEN").

1. Auto-mix is "ON" when luminous lines or circle on lever line up with luminous dot or square regulator.

2. Gives you all the oxygen you need, at any altitude. Like an automatic carburetor, it dilutes oxygen with as much air as you can stand, but it always keeps you at ground level efficiency.

3. Gives a mixture of air and oxygen:
   10,000 feet—approximately 35 percent oxygen
   18,000 feet—approximately 55 percent oxygen
   26,000 feet—approximately 85 percent oxygen
   Above 34,000 feet—100 percent oxygen

4. *Conserves oxygen:* Increases duration of your oxygen supply at 25,000 feet by about 30 percent.

AUTO-MIX "OFF" ("100% OXYGEN").

1. Auto-mix is "OFF" when luminous lines or circle on lever not lined up with luminous dot or square on regulator.

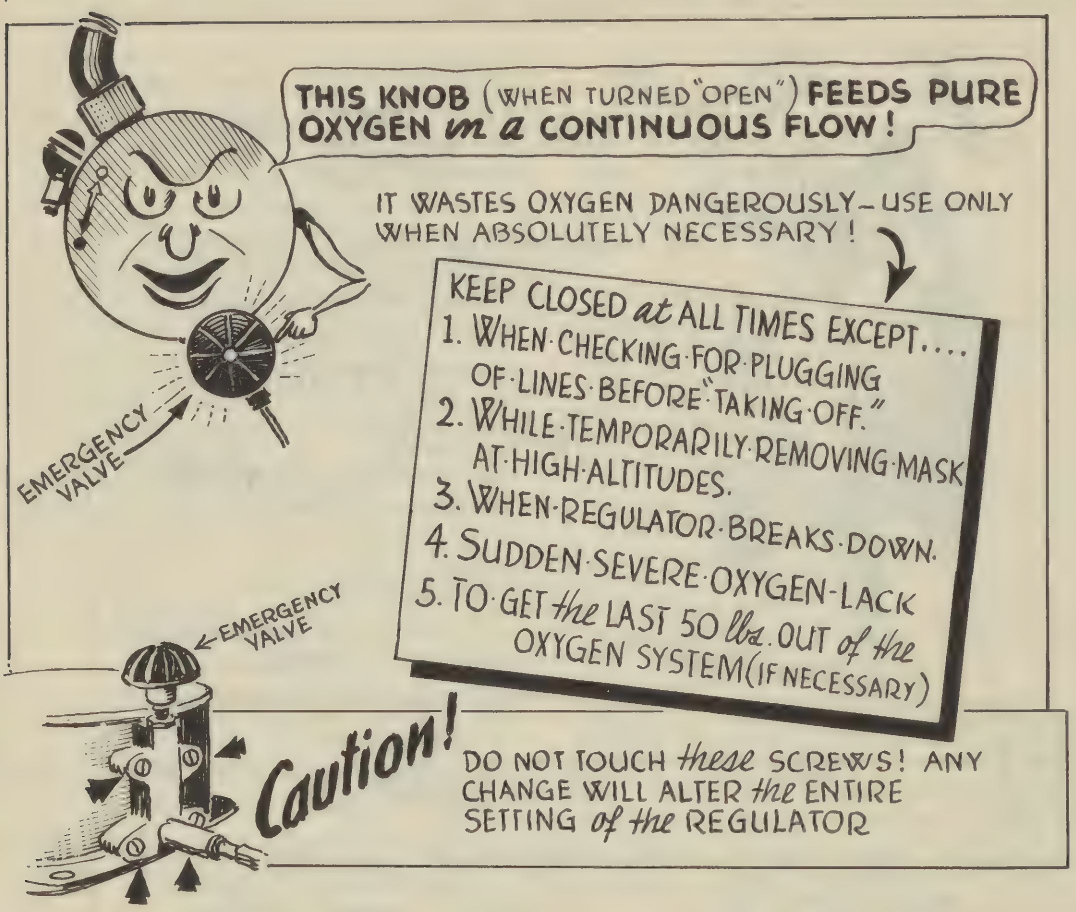
2. Gives you more oxygen than you need or can use at altitudes below 34,000 feet. *Oxygen is wasted* unless emergency demands it.

3. Gives 100 percent oxygen "on demand" at *all* altitudes. Wastes oxygen.

4. Wastes oxygen: Oxygen duration about 30 percent less on an average mission.

WHEN TO USE AUTO-MIX "OFF" ("100% OXYGEN"). These are the only times you should use the auto-mix in the "OFF" ("100% OXYGEN") position:

1. When you are suffering from oxygen lack
2. When you are wounded or injured
3. When exposed to fumes or other poison gas
4. In preflight check for holes in regulator diaphragm
5. On special high altitude missions to prevent "bends." Flight Surgeon will give specific instructions on such occasions.



The emergency knob

The emergency valve is dangerous! Causes waste of oxygen! Makes missions fail!

WHAT EMERGENCY DOES. Emergency valve changes regulator from demand to continuous flow. Oxygen flows continuously as long as it is open. If left open, it cuts down the duration of your oxygen supply by 80-90 percent!!! In other words, a 5-hour oxygen supply would last for only 1/2 hour (original A-12 Regulator with round-top emergency knob) to 1 hour (revised AN 6004-1 regulator with flat-top emergency knob), if you left the emergency knob open!!

HOW TO USE EMERGENCY.

1. Have a specific emergency reason for using it.
2. If you have to use it, use it intermittently, on and off, whenever possible, rather than leave it open.
3. If you have the original type regulator (Airco or Pioneer) with round-top emergency knob, never open emergency wide—just barely cracking it will give you all the oxygen you need.
4. Be sure that emergency knob is turned off tight before take-off!
5. Never pinch off hose (to test mask), when emergency is turned on—you may blow out the regulator diaphragm.

WHEN TO USE EMERGENCY. *Practically never!* Keep your hands off that red knob. It's *"hot."* It is meant only for urgent situations. There are only four occasions you'd ever use it:

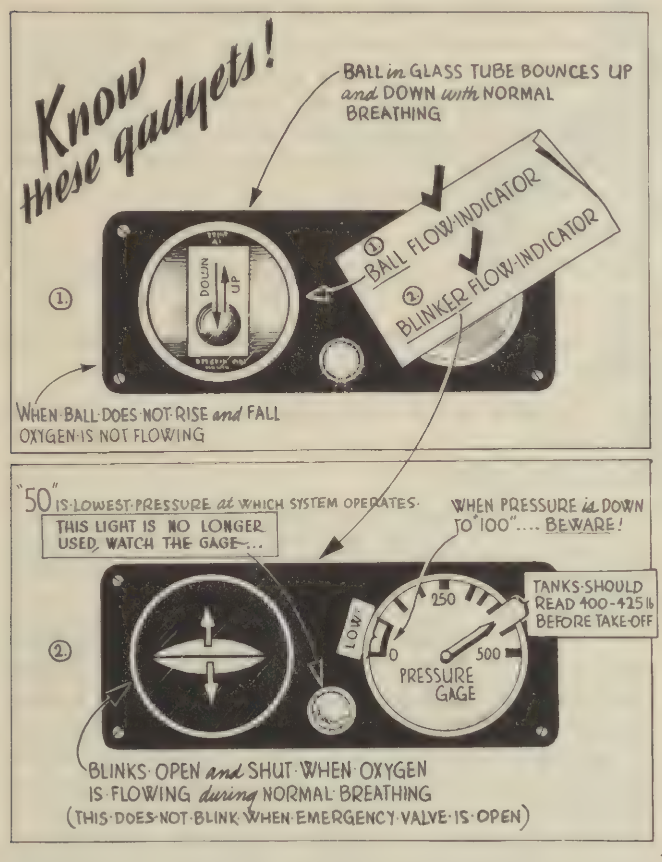
1. As preflight check to see that oxygen is coming through.
2. Sudden, severe oxygen lack due to:
   - Extreme mask leak
   - "Slipped" mask in pull-out
   - Hole in mask hose, etc.

Use emergency only as long as necessary to get mask readjusted. With hole in mask hose, try plugging up hole any way you can. With sudden, severe oxygen lack, always check immediately to see that rapid disconnect has not come apart. If disconnected, emergency flow will be useless.

3. *If you are a fighter pilot,* when regulator breaks down, for instance, ruptured diaphragm at altitude. In using emergency here, cover up opening on the front of the regulator to keep oxygen from pouring out to the outside. Use adhesive tape from first aid kit. *If you are an air-crew member* and your regulator breaks down, do not use the emergency. You have a better method, an alternative oxygen station. Get into your walk-around bottle, plug it into the recharger hose and leave it plugged in.

4. To get last 50 pounds of oxygen out of system,

if necessary! USE EMERGENCY WITH EXTREME CAUTION.



Oxygen instrument panel

FLOW INDICATOR. This reassuring gadget tells you that oxygen is flowing. There are two types: blinker and bouncing ball.

BLINKER. With the Pioneer regulator, blinks open when oxygen flows, shut when flow stops. With the Aro regulator it works in just the opposite fashion. Just remember this: Whether it opens and shuts, *or* shuts and opens, oxygen *is* flowing. The blinker does not work when the emergency is turned on.

BOUNCING BALL. The ball in the glass tube rises when oxygen flows, falls when it stops flowing. Remember this: The ball often gets "stuck" in the tube. Don't get "panicky" if it does; hitting the tube sharply with your finger will usually free the ball and start it working again. When you open the emergency valve, the ball will rise and not come down until the emergency is shut off.

Both the blinker and the bouncing ball tell you oxygen is flowing, but they do not tell you whether the mixture (percent oxygen), is right. If you were not getting the proper percentage of oxygen, you could be aware of it only through your symptoms of oxygen-lack. If you experience such symptoms, turn the automix "OFF" ("100 percent OXYGEN"). They should disappear quickly. If they do not, proceed cautiously to the use of the emergency for a short while.

SPECIAL NOTE ON DURATION. If you have the Pioneer regulator and the blinker type of indicator, you must figure on a shorter duration of your oxygen supply. The reduced duration depends on the length of the line running from the regulator to the blinker. If it is 1 foot long or less, figure on 15 percent less duration; if it is 5 feet long or more, figure 50 percent less; figure proportionately between 1 and 5 feet. If you have a long line from regulator to blinker, it is best to have an Aro regulator. *This applies only if you have both the Pioneer regulator and the blinker.*

OXYGEN PRESSURE GAGE. The pressure gage is *your* personal fuel gage. Check it at regular intervals. It gives you the oxygen pressure in the cylinders and lines.

DROP AFTER COOLING (FILLING). Your oxygen cylinders, originally charged to 425 psi, often show a drop in pressure when, having gotten hot during filling, they cool off afterwards. The pressure may drop 15 to 50 psi.

A drop of more than 50 pounds over-night is not due to cooling. It is due to a leak. If the pressure drops more than 50 psi after filling, *look for a leak. Notify ground crew or crew chief.*

ACTUAL OPERATING ZERO.

The zero mark is not your zero!

The 50 pound mark is your zero!

You get little or no "demand" oxygen below 50 psi, so make plans to be down at 10,000 feet or below by the time the gage reads 50. *If* you are ever "stuck" at altitude with only 50 pounds of oxygen, and the tactical situation doesn't allow immediate descent, you can get the last 50 pounds by using the emergency. *Don't do that* unless you *have* to, for two reasons:

1. The emergency flow will drain 50 pounds of oxygen in 2 to 4 minutes.

2. Draining the oxygen system below 50 psi may allow moisture to get into the lines. The next time you go to altitude, the moisture freezes and *blocks your lines.*

SIGNAL WARNING LIGHT. Demand oxygen systems were originally equipped with a signal warning light, designed to flash on when pressure dropped below 100 psi. Because of service troubles with this device, it has now been removed. Therefore it is more important than ever to *watch the gage.*

PRESSURE DROP CAUSED BY LOW TEMPERATURE. Don't be alarmed if you notice that your oxygen pressure is dropping as you ascend to high altitudes. This drop is caused by reduced temperature and does not mean that oxygen is leaking out. Every ten degree (Fahrenheit) drop in temperature will cause an 8 psi drop in pressure. For example, a 100° F drop will reduce oxygen pressure by 80 psi.

Oxygen cylinders, lines and check-valves

CYLINDERS. The Army Air Forces uses only low-pressure cylinders (yellow-maximum charge 450 psi) in aircraft, in preference to high-pressure cylinders (green —maximum charge 1800 psi) for two main reasons:

1. All cylinders can be filled through a single filler-valve without removing any of them from the aircraft.

2. They are safer under gunfire. A low-pressure cylinder will not explode when hit by gunfire if: it is banded, or, even though it is not banded, it is marked "non-shatterable." (If an aircraft has cylinders with neither bands nor the conventional markings, don't charge them to more than 350 psi.)

NOTE: Low-pressure cylinders are tested to 1,000 psi! But they must never be filled over 450 psi because a pressure greater than that will always damage the demand regulator.

LINES. Your oxygen system has two types of lines: Filler lines run from the filler-valve to one end of each cylinder. Distribution lines which come out of the other end of the cylinder, and join with distribution lines from other cylinders, finally ending up at the regulator.

All oxygen lines are painted at 18-inch intervals with a 1/2 inch stripe. The filler line stripe is green-yellow-green. The distribution line stripe is all green.

CHECK VALVES. The cylinders and lines are equipped with check valves. A check-valve allows flow in only one direction, so that if a cylinder is hit or a line shattered by enemy gunfire, not all oxygen in the system will be lost. *(Exception:* If the very short strip of line beyond the last check-valve near the regulator or the regulator itself is smashed, all the oxygen supply will be lost for that station.)

LOSS OF SUPPLY THROUGH GUNFIRE. How can you tell if a cylinder has been hit? You can't. The pressure gage will drop to zero *only* if you lose your entire supply, but it won't drop if you have even one cylinder left—because it shows pounds per square inch. It may fall faster, with one or more cylinders shot out, as you use oxygen, but in combat you're usually too busy to notice the speed of fall.

The best rule to follow is this: If your ship is hit, the oxygen supply is unpredictable. Following this rule will keep you "on the ball." It will keep you checking your pressure gage, and if you do that, you won't get into trouble.

Portable oxygen cylinders

THE PRICE OF FREEDOM IS ETERNAL VIGILANCE! Your walk-around bottle gives you *freedom* from a fixed oxygen station, but it requires *vigilance* if you want to stay out of trouble. The key to success is: *Watch the pressure gage on the walk-around assembly!!*

WHAT IS THE WALK-AROUND? A low-pressure oxygen cylinder, with a clip for your clothing or a harness for your shoulder, and a regulator.

Three types of walk-around bottles are used. All three have pressure gages to tell you when the supply is running low. Two of the portable cylinders supply you 100 percent oxygen; the other (the A-6) has a diluter-demand regulator which dilutes the oxygen with air, depending on your altitude. The portable cylinders can be refilled in your ship.

WHAT'S IT FOR?

1. To allow you to move around the ship away from your oxygen station.

2. To revive any fellow crew-member who gets into trouble away from an oxygen station.

3. To serve as an extra oxygen station, in case of emergency.

AND THE TYPES?

1. The A-4, a small, fat, green (but low pressure!) cylinder with a clip for the clothing. This is the original walk-around bottle. It has a volume of 104 cubic inches.

2. The A-6, a somewhat larger, fat, yellow cylinder with a clip for the clothing. It has a volume of 280 cubic inches. The A-6 has no auto-mix lever, but it does have an auto-mix (diluting) mechanism; it automatically mixes air with oxygen, the amount depending on the altitude, up to 34,000 feet, where it gives 100 percent oxygen.

3. The D-2, a much larger, slender, yellow cylinder with a harness for the shoulder. Though it may be used as a walk-around bottle, it is best used as an *emergency* supply; for instance, if your oxygen system has been shot out, or to revive a fellow crew-member who has passed out from lack of oxygen away from an oxygen station. The D-2 cylinder has a volume of 500 cubic inches.

HOW IS IT USED? You take a deep breath, hold it, pull the end of your mask-hose out of the regulator hose, and plug it into the opening (lift the cover!) on top of the walk-around regulator, next to the pressure gage. Plug it in tight. Now start to breathe again.

You can carry the A-4 or A-6 clipped to your clothing, or the D-2 harnessed around your shoulder. But—in "tight" places, like the cat-walk, you will have to hold the walk-around bottle in your hands as you squeeze through. Watch for kinking or twisting of the hose. If you suddenly can't breathe, don't get panic-stricken. Check your mask hose for twists or kinks. Turn the walk-around bottle as necessary to untwist the mask hose. The only other reason you "can't breathe" on a walk-around is an empty bottle. Keep it filled! *Never* let the gage get down below the 100 psi mark.

HOW LONG WILL IT LAST? If you want to last, think of the duration of your walk-around bottle in terms of pressure. WATCH THAT GAGE! HEAD FOR THE NEAREST RECHARGER HOSE AS SOON AS THE GAGE REACHES THE 100 POUND MARK.

There is a recharger hose at every oxygen station in your ship. If your walk-around bottle is full—425 psi—it will last, *depending on how much work you are doing and on your altitude:*

A-4 (fat, green cylinder)—3 to 7 minutes.
A-6 (fat, yellow cylinder)—15 to 40 minutes.
D-2 (long, yellow cylinder)—20 to 50 minutes.

Curiously enough, the higher your altitude, the longer it will last. The more "work" you do, the less time it will last. A full D-2 used by a resting flyer at 30,000 feet may last almost a full hour. A half-filled A-4 used to crawl into the tail at 20,000 feet may last only 1 minute!

DON'T TRUST THE WALK-AROUND.
FORGET TIME—THINK OF PRESSURE.
WATCH THE GAGE, NOT YOUR WATCH.

Remember, too, that the walk-around will be filled to its capacity of 425 psi only once—on the ground before take-off. When you've used it and have to fill it again at altitude, some of the oxygen in the ship's supply will have been used up, and you may only be able to fill it to 300 pounds or less. *Watch the pressure gage!!*

HOW DO YOU REFILL IT? The walk-around bottle is refilled from a 2-foot recharger hose. There is a recharger hose at every station in the ship. Always use the nearest one, and know the location of every station and every recharger hose in your ship, so you can find any one of them in the dark. You need not plug your mask out of the walk-around while refilling it.

To refill, twist the handle on the end of the recharger hose, and the plug will fall out. Plug the metal nozzle sticking out of the walk-around regulator (near the bottom) into the recharger hose.

PLUG IT IN TIGHT UNTIL IT CATCHES. If you fail to do this, the oxygen will not go into your bottle, but will leak out into the air. When the needle on the pressure gage shows the same pressure or a little less than the ship's oxygen system, twist the handle of the recharger hose clockwise and the connection will be released. *Don't forget to put the plug back into the recharger hose.*

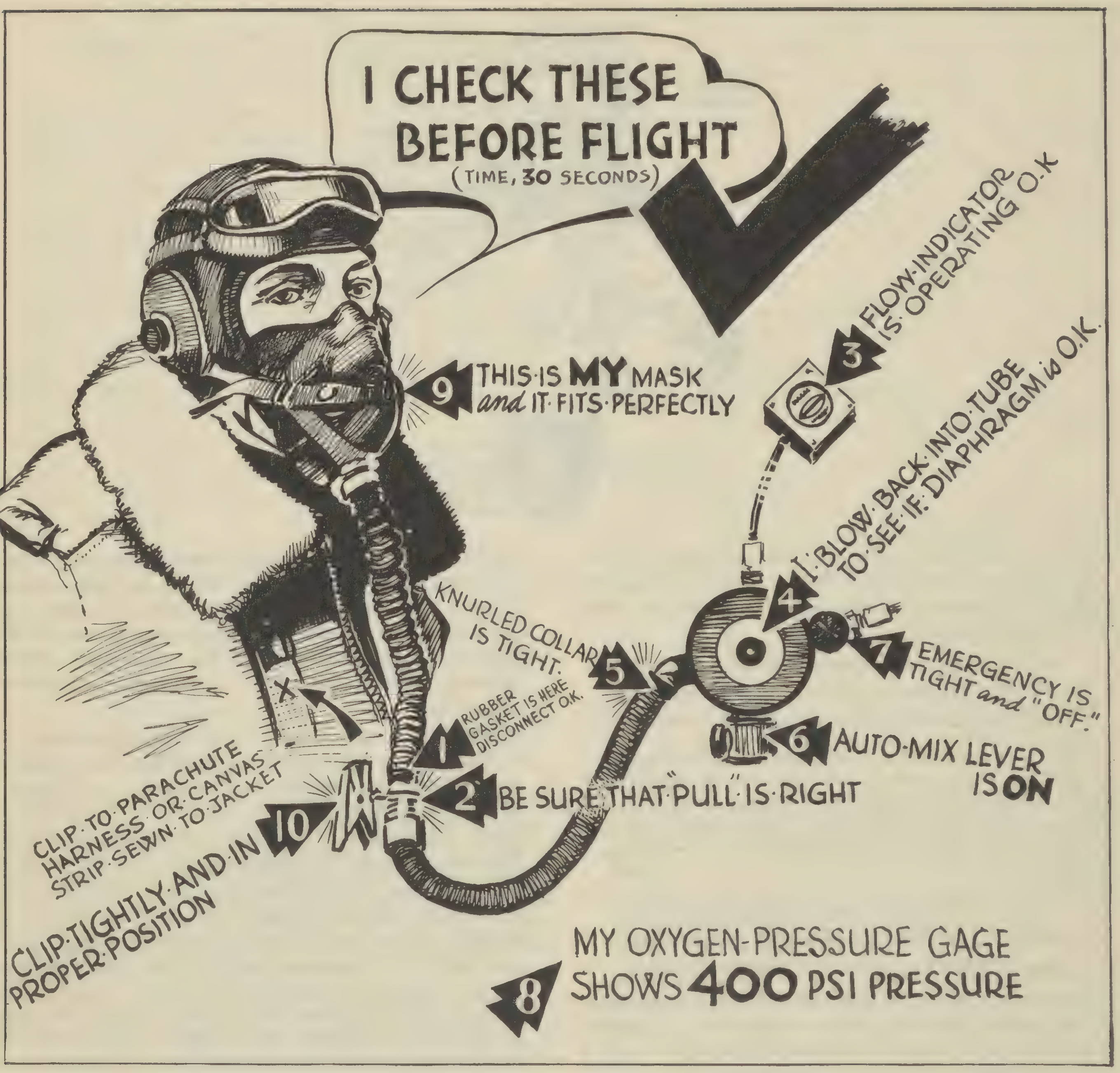
Refill your walk-around as soon as the gage reads 100. It does not work below 50 psi, and it has no emergency to give you that last 50 pounds. Don't get "stuck." *Refill at 100 pounds.* And always fill your walk-around before you leave your station to go walking in the ship. The safe way is to fill the walk-around every time you're through using it. The next time you need it you may be in such a hurry that you won't have time to fill it.

NOTE. If the jaws of the recharger hose-filler valve get "stuck" in the open position (as from freezing) oxygen will pour out and drain the ship's supply. Try ramming the walk-around in and out a couple of times, or striking the recharger hose (metal end) on metal. If that will not release the jaws and stop the oxygen flow, leave the walk-around plugged in. That will *save* the ship's supply.

EXTRA OXYGEN STATION. Your walk-around bottle can serve as an extra oxygen station. If your particular oxygen system gets shot out (for instance, there are four separate "systems" in a B-17), plug into your walk-around and then plug it into the nearest recharger hose on a different system; leave it plugged in, and you are "on oxygen."

QUESTION: When do you take two walk-around bottles with you?

ANSWER: In going to help a fellow crew-member who is having oxygen troubles and has perhaps passed out away from an oxygen station. You take one walk-around for yourself and one for him. If possible, take a D-2 bottle for him.



Life insurance at altitude

60 years for 30 seconds

This book was written FOR THE FLIER. Every section in it is important. But—just suppose there were only one little section you could know. Which one would it be?

PREFLIGHT CHECKS, *the most important thing you can do to avoid oxygen troubles.*

Here's why. The demand system is not automatic unless it is in good working order. The only way you have of assuring yourself of that is to

DO THE 30 SECOND PREFLIGHT CHECK!

A defect discovered on the ground, where it can be corrected, means life. Undiscovered, that defect may cause serious consequences at altitude.

NOTHING WILL EVER PAY GREATER DIVIDENDS THAN THE 30 SECONDS YOU PUT INTO THE SIMPLE PREFLIGHT CHECK OF YOUR OXYGEN EQUIPMENT!

Here it is, the 10-point, 30-second preflight check—exactly as you can do it in your ship:

1. *End of mask hose in working order.* Check to see that metal end is perfectly rounded and not warped, and that rubber gasket is in place.

2. *Quick-disconnect secure.* Make the connection and then disconnect it. It must take at least a 12-pound pull to disconnect.

3. *Oxygen Flows on Demand.* With the auto-mix "OFF" ("100% OXYGEN"), breathe two or three times out of the end of the regulator hose to see that the blinker works, or the bouncing ball goes up and down.

4. *No Holes in Regulator Diaphragm.* With the auto-mix "OFF" ("100% OXYGEN"), cup your mouth over the end of the regulator hose and blow in gently. If you feel a resistance to your blowing, diaphragm is intact. If you are able to blow right on through, there is a hole or tear in the diaphragm and the regulator will not work.

5. *Elbow Adapter Tight.* Be sure the goose-neck elbow of the regulator cannot be moved. If it is loose, use a wrench to tighten the black collar screw just above it. And while you're at it, check to see that the regulator hose is *wired* to the elbow.

6. *Auto-Mix "ON" ("NORMAL OXYGEN").* Turn the auto-mix lever to the "ON" ("NORMAL OXYGEN") position. Keep it there!

7. *Emergency Knob Turned Off Tight.* Open the emergency knob for an instant to determine that oxygen is flowing through the lines, then shut it off tight.

8. *Pressure Gage Reads 400 psi.* This tells you that: you have an adequate oxygen supply for the mission and the pressure has not fallen more than 50 pounds since filling; therefore, there is no leak in the oxygen system.

If your pressure gage does not read 400 psi, check it against two other oxygen stations, one on your system and one on a different system.

9. *Mask Does Not Leak.* Hook your mask up to your helmet and test for leaks with the leak detector, or, if you haven't one available, with a careful suck test. Be sure your mask is leak-proof. Make any necessary adjustments before take-off.

10. *Attach Clip in Proper Place.* With your mask still on your face, make the connection between mask hose and regulator hose (rapid disconnect). Be sure it is properly sealed—push it in *all the way.* Now *use the clip* to attach the rapid disconnect *at the proper level* on the parachute harness or to a canvas strip sewn at the proper level to your flying jacket.

IMPORTANT NOTES. *If you are not flying a night mission,* you can unhook the right side of your mask—but leave the clip attached to your parachute harness. When you hook up your mask again at 10,000 feet, do another suck test by pinching off the mask-hose. The preflight test for mask leak is *not* a waste—if there is a leak, it is much easier to adjust straps, etc., on the ground than it is in flight.

If you are a member of an air crew check your walk-around bottle and portable emergency bottle to see that they are filled to 400 psi; *check* your recharger hose to see that it works, and then be sure the plug is inserted in it; *check* your bail-out bottle; it should show a pressure of 1800 psi.

If you are a fighter pilot check your bail-out bottle; it should show a pressure of 1800 psi.

Ten points! Thirty Seconds! What it amounts to is 60 years of life insurance for a premium cost of 30 seconds.

DO PREFLIGHT CHECKS BEFORE
EVERY TAKE-OFF!!!

CHECKS DURING FLIGHT.

1. Check mask fit (suck test by compressing hose and inhaling gently) each time mask is removed and replaced.

2. Consciously and deliberately check on your own condition every ten minutes to determine that you have no symptoms of oxygen lack.

3. Check pressure gage frequently.

4. In low temperatures, squeeze mask at intervals to prevent ice from forming.

5. If you have symptoms of oxygen lack, turn auto-mix "OFF" ("100% OXYGEN"). If you do not feel better within a minute, crack emergency—use it intermittently.

6. Never remove your mask without following the prescribed technique exactly.

CHECKS AFTER FLIGHT.

1. Wipe mask dry and put it away in proper place.

2. Report all defective oxygen equipment to ground crew immediately after landing. Make sure that it has been repaired or replaced before another mission is undertaken.

Oxygen emergencies at altitude

Any emergency is less dangerous if you: (1) Keep cool, (2) Don't get panicky, (3) Know what to do because you've thought about it and prepared for it *before* it happened.

EMERGENCIES AFFECTING YOU AT YOUR OXYGEN STATION

Trouble. You suddenly can't breathe; it feels as though someone had pinched off your mask hose and you are suffocating.

Cause. Your mask hose is kinked and blocked off—OR—your oxygen is gone *and* your auto-mix is in the "OFF" ("100% OXYGEN") position, where it shouldn't have been in the first place.

Cure. Don't pull your mask off! Keep cool! Quickly check your pressure gage. If the indicator is below 50, keep your mask on, but pull the mask hose out of the disconnect and get into your walk-around bottle. Then go immediately to an oxygen station that is on a different system from your own and plug into the recharger

hose there. Notify the pilot. (If you are a fighter pilot, use the bail-out bottle as an oxygen supply and head for lower altitude immediately.) If the indicator is above 50, take the clip off your flying jacket, straighten out the mask hose to unkink it, and you'll promptly be able to breathe freely. Put the clip back again, being sure to get the mask hose straight.

Trouble. You feel dizzy and light-headed, or your vision blurs, or you feel suddenly elated and pleased with yourself, or you can't think straight, or you can't remember what the pilot just said on the interphone.

Cause. You are suffering from oxygen lack.

Cure. Take the following steps in order.

1. Notify pilot on interphone immediately. (If you don't do this, and you pass out before you discover and correct the trouble, nobody will know you're in trouble and you will get no help.)

2. Check the blinker! If the blinker is not working, these are the possible faults:

1. *Quick-disconnect separated.* Connect it.

2. *Regulator hose* has slipped off goose-neck elbow. Get it back on and hold it on until you can secure it or get help.

3. *Pressure gage* shows less than 50 pounds. Turn open emergency until you feel better. Then close it, get into your walk-around bottle, and head for another oxygen station. In a fighter ship, continue to use the emergency, or use the bail-out bottle—and head for lower altitude.

4. *Hole in mask hose.* Open emergency valve; plug up hole any way you can—use gloved finger if necessary.

5. *If none of the above* four things is wrong, your regulator has broken down! Get into your walk-around and head for another station. In a fighter ship, use the emergency knob or the bail-out bottle and go to lower altitude.

If the blinker is working, turn auto-mix "OFF" ("100% OXYGEN"). If you do not feel better in half a minute, or you feel bad, open the emergency valve. While doing this, look for these possible faults:

1. *Hole in mask hose.* Open emergency; plug up hole any way you can.

2. *Pressure gage* less than 50 psi. Get into walk-around and go to another oxygen station.

3. *Mask leaks.* Adjust mask if possible. Use emergency intermittently if necessary.

4. *Rubber gasket missing* from quick disconnect. If extra gasket is not available, turn emergency on at intervals and for very short periods of time.

5. *Elbow adapter* of regulator is loose (movable). In bomber, get help and tighten collar screw with wrench. In fighter ship, use emergency on and off—get down to lower altitudes as soon as possible.

6. *If none of the above* five things is wrong, your regulator is not delivering the proper percentage of oxygen. Turn auto-mix "OFF" ("100% OXYGEN").

EMERGENCIES WHILE YOU ARE USING A WALK-AROUND BOTTLE.

Trouble. You suddenly can't breathe, it feels as though someone had pinched off your mask and you are suffocating.

Cause. Your mask is twisted and blocked off—*or* your walk-around bottle is empty.

Cure. Don't pull your mask off! Keep cool! Quickly check the pressure gage on the walk-around bottle. If the indicator is below 50: pull your mask hose out of the cylinder (breathing air with too little oxygen is better than suffocating), and get to the nearest help or oxygen station as quickly as possible. If the indicator is above 50, your mask hose is blocked. Remove the clip from your clothing, turn the bottle as necessary to straighten the hose, and you will immediately be able to breathe freely.

EMERGENCIES AFFECTING A FELLOW CREW MEMBER AWAY FROM HIS STATION.

If you see a fellow crew member who is slap-happy from oxygen lack, or who has passed out, the first thing to do is notify the pilot.

Do not try to drag him to an oxygen station. Your walk-around bottle will not last long enough to permit you to do that much work, and

Do not rush to his aid without a walk-around or with only one walk-around.

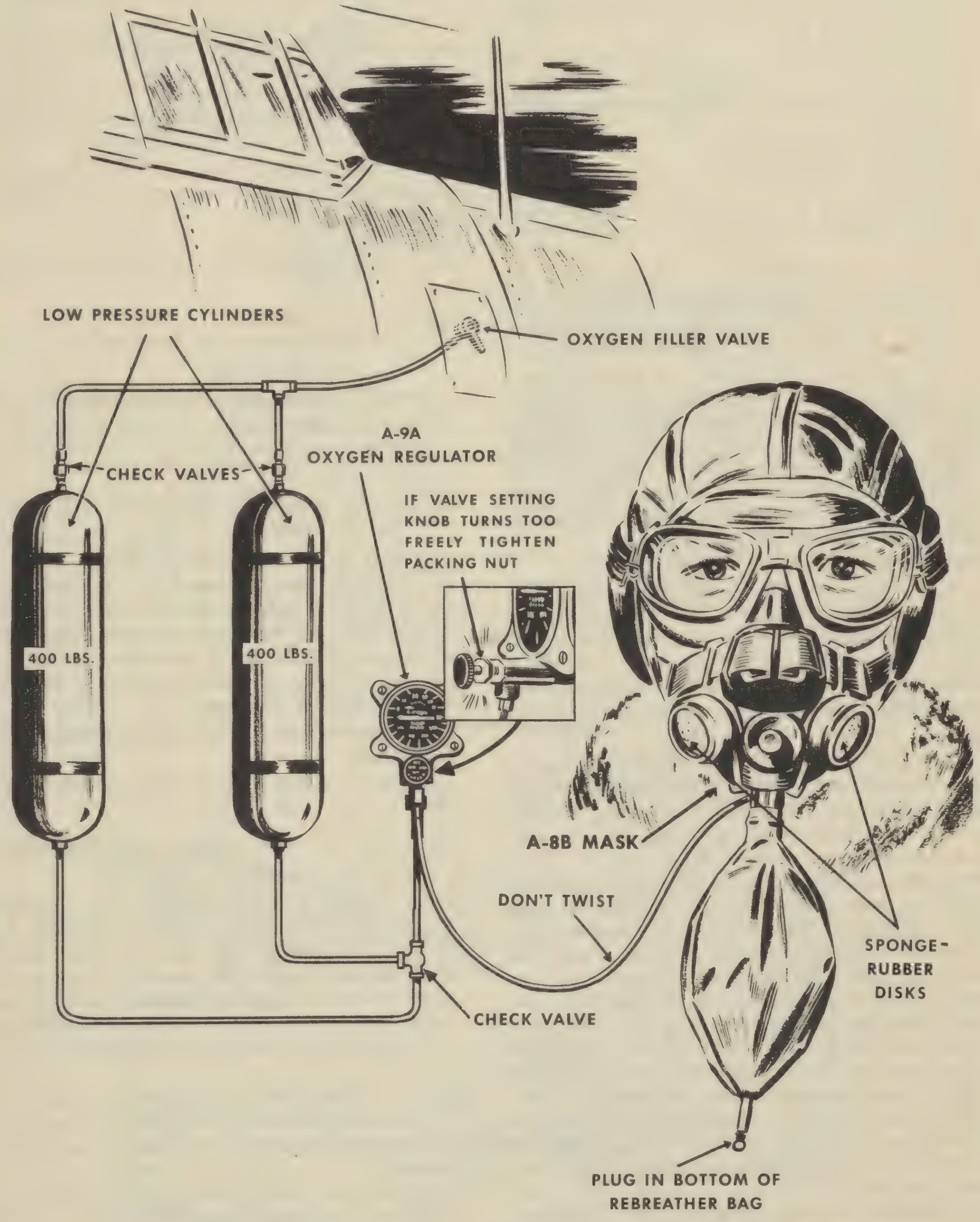
What to do: Take two portable cylinders with you, making sure they have enough oxygen in them. Plug into one (a walk-around A-4) yourself and take an emergency cylinder (if possible, the big D-2) for the man you're going to help. See that his mask is on and plug it into the portable cylinder. If he is breathing, he will come to very quickly. If he is not breathing, or his breathing is shallow, you will have to give him artificial respiration. This is hard work and you can't keep it up very long on your A-4 walk-around. You must get help, someone to hand you filled walk-around bottles and to alternate in giving artificial respiration.

When your man starts to come to, watch him—he may come up fighting. When he is conscious, let him get back to his oxygen station under his own power, but watch him until he's plugged in there, and "all set." Check his oxygen equipment (mask, clip, disconnect, auto-mix, emergency), to see that all is as it should be. He may still be too "woozy" to do this properly himself.

DON'T PULL THE BONER OF GOING TO AID SOMEONE IN DISTRESS AND PASSING OUT YOURSELF. SEE THAT *YOU* HAVE A SUFFICIENT OXYGEN SUPPLY FOR YOURSELF.

It is best, in going to revive someone, to have another crew member watching *you* and standing by to assist if necessary.

EMERGENCY AFFECTING A FELLOW CREW MEMBER AT HIS STATION. Treat these troubles the same way described under "Emergencies Affecting You."


LOW PRESSURE CYLINDERS
OXYGEN FILLER VALVE
CHECK VALVES
A-9A
OXYGEN REGULATOR
IF VALVE SETTING
KNOB TURNS TOO
FREELY TIGHTEN
PACKING NUT
400 LBS.
400 LBS.
A-8B MASK
DON'T TWIST
SPONGE-
RUBBER
DISKS
CHECK VALVE
PLUG IN BOTTOM OF
REBREATHER BAG

The continuous-flow oxygen system

The Demand Oxygen System is found in all the newer Army Air Forces combat aircraft and has been installed in some of the older airplanes. But—

You may find yourself in one of the ships that still has the Continuous-Flow Oxygen System. It will supply you well with oxygen if you know the main points in its operation.

PRINCIPLE OF OPERATION.

1. *Cylinders, lines and check-valves* are low-pressure, just like the demand system. Pressure is registered on the pressure gage—the lower dial on the face of the regulator.

2. *Regulator.* (A-9A) Entirely different from the demand regulator. It is not automatic. You get a continuous flow of oxygen by turning open the regulator flow valve and watching the needle on the flow indicator dial (upper dial on the face of the regulator). The dial is graduated in thousands of feet. You open the valve until the needle on the dial points to the same altitude as that registered by your altimeter. In bombers the pilot calls out the altitude over the interphone, so that all the crew can adjust their regulators. If you keep the needle on the flow indicator dial corresponding to your altitude, you get the proper amount of oxygen for any altitude at which you are flying.

3. *Mask.* The A-8B mask is used with the continuous-flow system. This mask is easily fitted by loosening or tightening the supporting straps, and no special test is required. Two turrets in the face-piece of the mask contain sponge-rubber discs which have two purposes:

a. Your exhaled air passes out of the mask through them, and

b. They act as a primitive auto-mix, allowing you to take in some air at the lower altitudes. This air is mixed with the oxygen you are getting, and in this way you conserve oxygen. Less and less air comes in as you gain altitude; and none enters above 30,000 feet.

When you are exposed to freezing temperatures at altitude, you must squeeze the sponge-rubber discs at frequent intervals to drain them of the moisture from your breath. Otherwise, this moisture may freeze and block up the discs. The face piece of the mask is connected to a rubber rebreathing bag. Oxygen flows continuously from the regulator through a thin rubber hose into the rebreathing bag. It is kept there while you exhale and goes up into the mask when you inhale. Thus the bag fills and empties with your breathing. The plug in the bottom of the rebreather bag should be removed for a few seconds (while you hold your breath) once in a while at altitude; this allows drainage of any accumulated moisture.

4. *Connection between Mask-Hose and Regulator.* This is a bayonet connection. The metal end of the mask hose is plugged into the regulator outlet and then turned so that it "locks" in. The rubber washer must be present on the end of the mask hose. The hose is of small caliber and is easily kinked, compressed, and shut off. *Watch the hose—don't* step on it, sit on it, kink it, or twist it.

IMPORTANT POINTS
IN USING CONTINUOUS-FLOW SYSTEM.

1. Rebreather bag should never empty completely when you need 100 percent oxygen (above 30,000 feet), since complete emptying allows air to be pulled in through the sponge rubber discs. If the bag empties completely when you inhale above 30,000 feet, turn open the regulator valve until it stops doing this.

2. If the regulator valve turns too easily (has too much "play"), tighten the packing nut behind the valve knob.

3. Carry an extra mask with you if you go to altitudes above 20,000 feet—in case the mask you are wearing should freeze.

PREFLIGHT CHECKS
OF CONTINUOUS-FLOW SYSTEM.

1. Pressure gage 400 psi.

2. Open regulator flow valve wide and see that needle registers maximum on flow indicator dial.

3. Flow valve knob must not turn too easily (have too much "play").

4. Rubber gasket present at end of mask hose.

5. Bayonet connection "locked."

6. Plug in bottom of rebreather bag.

7. No holes in rebreather bag. (To check for this: Use your thumb to block up outlet from inside of mask to rebreather bag; turn flow valve open long enough to fill bag; check inflated bag for holes.)

8. Check to see that rebreather bag is securely connected to neck of face-piece.

9. Check to see that each turret contains a sponge rubber disc.

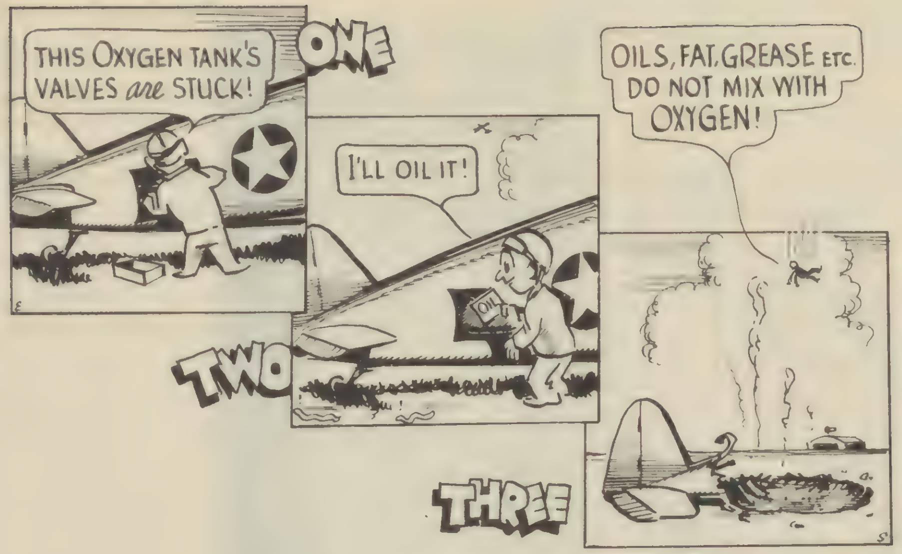
10. Adjust mask straps for comfortable fit without leaks.

Grease or oil plus oxygen equals sudden death

DON'T ALLOW OIL, GREASE, OR HYDRAULIC FLUID TO GET NEAR ANY OXYGEN EQUIPMENT!!! Remember this! The explosion when any of these substances comes in contact with oxygen may be more violent than igniting dynamite! Anyone handling or servicing oxygen equipment should have clean hands or clean gloves—it may take very little oil to do the trick.

DON'T WEAR GREASY CLOTHES WHEN WORKING WITH OXYGEN! Oxygen may cause substances with merely a trace of oil or grease to burn with great intensity.

DON'T EVER USE LUBRICANTS IN THE OXYGEN SYSTEM. Remember those DON'TS! — even though somebody tells you that *he* knows a guy who got oil on an oxygen line and nothing happened. The answer to that is that: guns *occasionally* don't go off. Matches *sometimes* don't light. Fools don't live long!



Gas mask versus oxygen mask (The winner—gas mask)

DON'T BE TAKEN BY SURPRISE! There's always a first time! The enemy didn't give any advance notice when he used poison gas in the last war. He may use it just as suddenly this time.

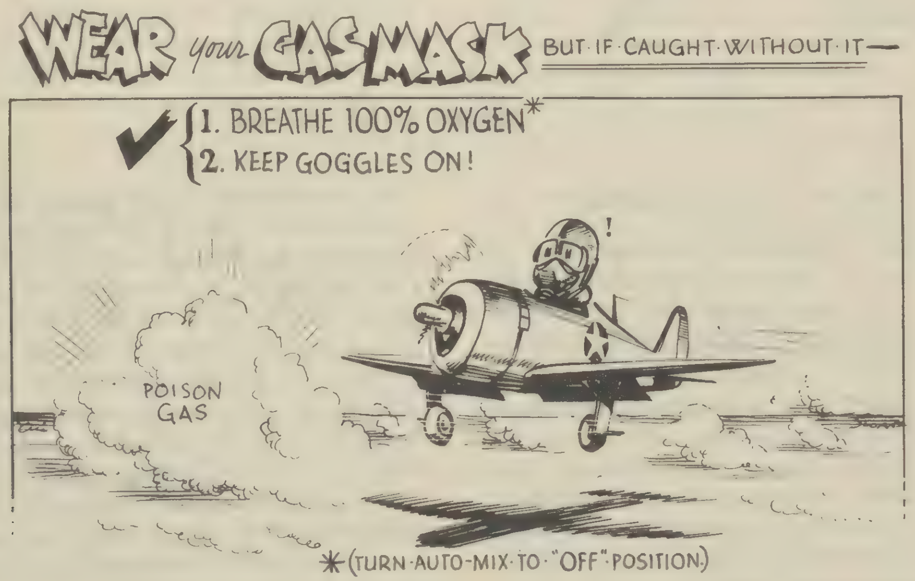
FOR THE FLYER WHO IS ON THE BALL. On the day you return from a mission to find that gas has been dropped on your field, you will put on your gas mask and be thankful that you didn't consider it "excess baggage." Now that you've *got* to have it, you can see that it was more than worth it to have it along on dozens of occasions when "it wasn't necessary."

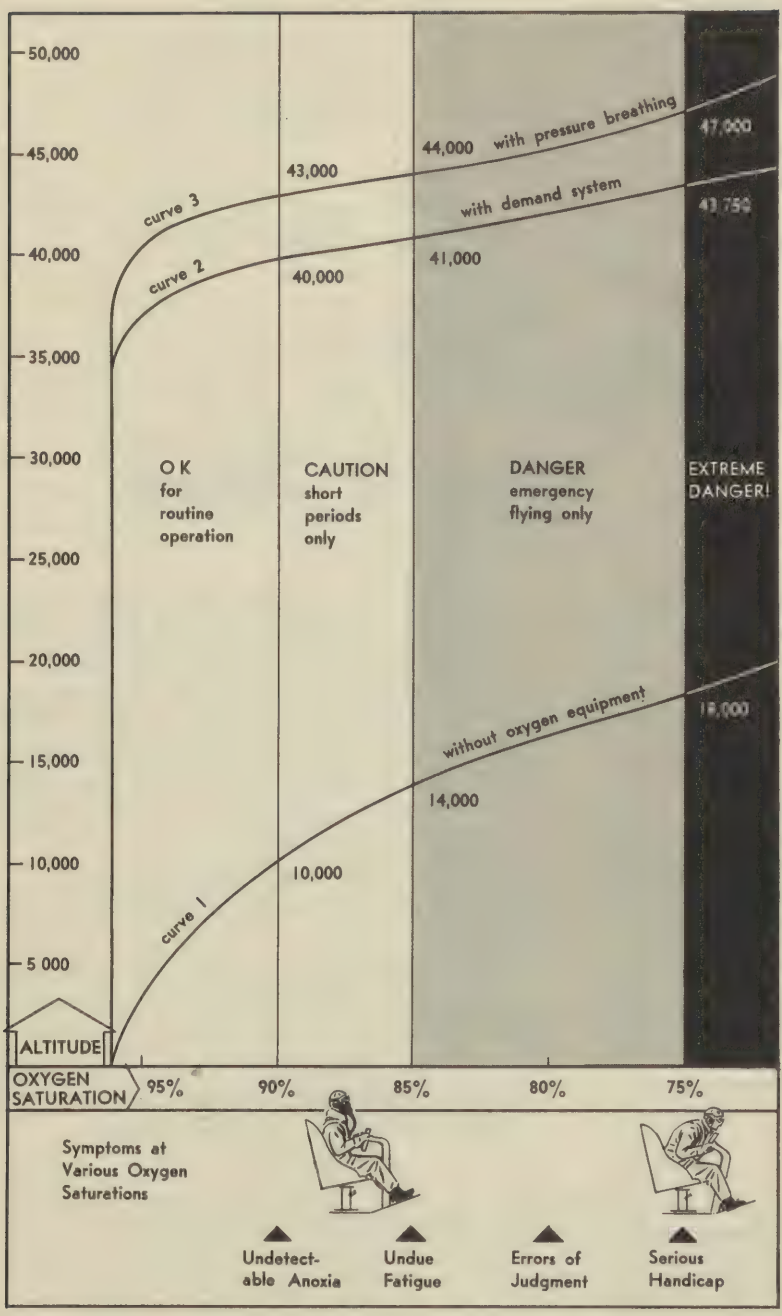
FOR THE FLYER WHO PULLS A BONER. You're caught off guard!

Gas on the field—you didn't take your gas mask—you're short on gasoline and can't fly to another field. Fortunately, even though they are not as good as a gas mask, your oxygen mask and goggles will help you considerably in this situation. Put them on, being sure they fit tightly, and turn the auto-mix lever of your demand regulator to "OFF" ("100% OXYGEN"). If you have the continuous flow system, turn the regulator flow valve all the way open. Now your eyes are more or less protected and your throat and lungs are isolated from surrounding gas.

BUT THE GAS MASK WINS because—

1. It gives you more complete coverage and protection.
2. It allows you to leave your plane, whereas your oxygen mask confines you to the ship unless someone on the ground can get a gas mask to you.
3. Your oxygen mask is good only as long as the oxygen supply holds out—and you will not have much oxygen left at the end of a mission.





The relation between altitude and blood oxygen saturation is shown for the flyer without oxygen equipment (curve 1); with the demand system (curve 2); and with pressure-breathing (curve 3). Curves 2 and 3 are based on the assumption that no mask leakage occurs. A special advantage of pressure-breathing is that it completely eliminates the chance of inboard mask leaks.

How to raise your ceiling

Earlier in this book you learned the importance of oxygen pressure. Oxygen pressure in the lungs is the thing that counts! You also learned that, even if you breathe 100 percent oxygen with regular demand oxygen equipment, you have *two* "oxygen ceilings":

1. *34,000 Feet:* is the highest altitude to which you can go and still get as much oxygen into your blood as you have when you breathe air at ground level. This is the "oxygen ceiling for ground level conditions." Above 34,000 feet, the oxygen pressure in your lungs begins to fall, as it does when you go from sea level to 10,000 feet without an oxygen mask.

2. *40,000 Feet:* is the highest altitude at which you can fly safely. This is the "oxygen ceiling for safety." In an emergency, you might go as high as 43,000 feet ("oxygen ceiling for emergency"), but it would be dangerous to stay there for even a few minutes. Just as 34,000 feet when you breathe 100 percent oxygen corresponds to ground level when you breathe air—so 40,000 feet when you breathe 100 percent oxygen corresponds to 10,000 feet when you breathe air.

YOU CAN RAISE YOUR "OXYGEN CEILINGS" in *two* ways: pressure breathing and pressure cabins.

Both methods increase the oxygen pressure in your lungs, the first by "pressurizing the lungs," the second by "pressurizing the cabin."

Pressure breathing

WHAT IS PRESSURE BREATHING? Pressure breathing is a method of raising your ceiling. Oxygen is delivered to your mask under a positive pressure, in order to raise the oxygen pressure in your lungs. You regulate the delivery pressure of oxygen according to how much you have to raise your lung oxygen pressure, and that depends on your altitude. The delivery pressure is measured in inches of water. Pressure breathing equipment allows you to use oxygen under a positive pressure of up to 12 inches, although we use only pressure of up to 8 inches, except in case of emergency.

HOW PRESSURE BREATHING CHANGES THE WAY YOU BREATHE. In normal breathing: breathing in requires effort. Breathing out doesn't. In pressure breathing: breathing in requires little or no effort. It becomes much easier to inhale, because the oxygen flows into your lungs "under its own power." With 4 or more inches of water pressure you "inhale" without any effort at all! Breathing out takes effort because you are exhaling against pressure. This feels a little odd at first, but you get used to it very quickly. You can breathe for several hours without any discomfort against 6 to 8 inches of water pressure. It becomes a little difficult at pressures much higher than this, though, and it requires special training to be able to breathe against 12 inches of water for even a short while. The *important* thing is that you get used very quickly to as much as 8 inches of pressure and can breathe against it for hours without difficulty.

ADVANTAGES OF PRESSURE BREATHING. Pressure-breathing demand oxygen equipment does four things for you that regular demand oxygen equipment does not do:

1. *Pressure Breathing Gives You a Safety Factor Between 30,000 and 40,000 Feet.* The use of a pressure of 2 inches between 30,000 and 40,000 feet is called "safety pressure." Breathing against this pressure at these altitudes gives you a safety factor in two ways: by raising your "oxygen ceiling for ground level conditions" a few hundred feet; and, even more important, by guaranteeing that you breathe the 100 percent oxygen which your oxygen regulator is delivering to your mask. You get 100 percent oxygen at very high altitudes with regular demand oxygen equipment only if your mask fits perfectly. A small mask leak may not amount to much at the lower altitudes, but it grows much bigger at the higher altitudes and prevents you from actually getting 100 percent oxygen into your lungs.

Pressure breathing is extra insurance against this—it guarantees you 100 percent oxygen because it supplies it under pressure. It compensates for possible mask leaks.

2. *Pressure Breathing Raises Your "Oxygen Ceiling For Safety" From 40,000 To 43,000 Feet.* Breathing against pressure will raise your "oxygen ceiling for safety." Your "oxygen ceiling for safety" is

10,000 feet without oxygen equipment;

40,000 feet with regular demand oxygen equipment;

41,000 feet if you breathe against a pressure of 4 inches of water;

43,000 feet if you breathe against a pressure of 6 to 8 inches of water;

3. *Pressure Breathing Raises Your "Oxygen Ceiling For Emergency" From 43,000 Feet to 47,000 Feet.* In an extreme emergency you can go to 47,000 feet if you breathe against a pressure of 12 inches. It is dangerous to stay there, however, for even a few minutes—and remember that breathing against 12 inches of water pressure is difficult even with training.

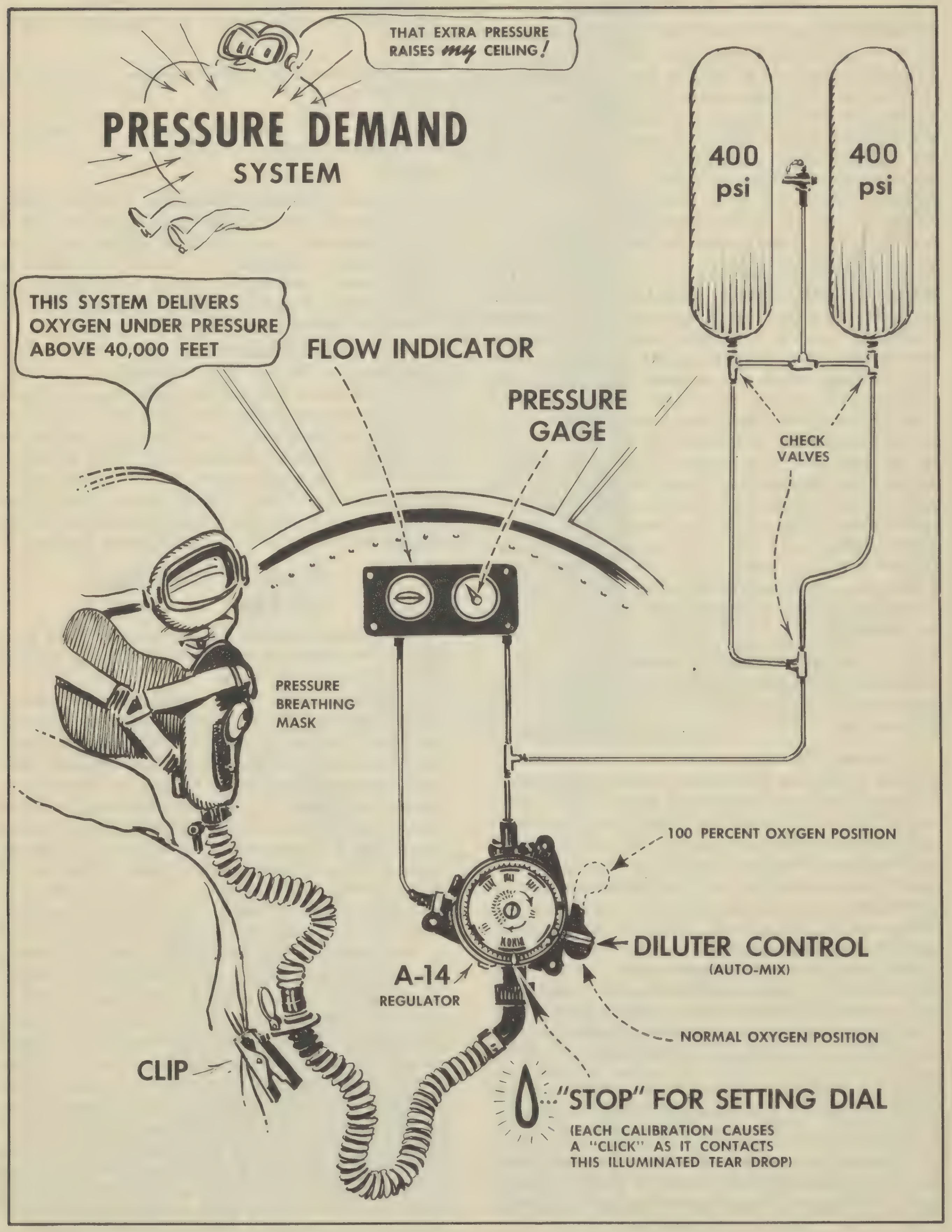
4. *Pressure Breathing Protects You If Your Pressure Cabin Loses Its Pressure.* As is explained in this section on pressure cabins, penetration of the pressurized cabin by gunfire causes a sudden loss of pressure. This brings the flyer who occupies the cabin in contact with the low atmospheric pressure outside the plane. He might not have needed the oxygen before, but he needs it now—and in a hurry! If this were to happen above 40,000 feet, it would be extremely dangerous unless you had pressure-breathing equipment immediately available.

Pressure demand oxygen system

The pressure-breathing demand oxygen system is the same as the regular demand oxygen system, except for the *regulator* and the *mask.*

THE REGULATOR. The pressure-breathing demand oxygen regulator (A-14) is nothing more than the regular demand oxygen regulator (revised type, AN 6004-1) to which a spring-weighted diaphragm has been added for pressure breathing. It can be used as either a regular demand regulator or a pressure breathing regulator. It looks very much like the regular demand regulator, except that it has no red emergency knob on the side; instead, it has a flat cover-plate knob. When one side is turned up, the cover-plate knob shows the word "Emergency" in red letters; this is like the emergency knob on the regular demand regulator and is for use in emergencies below 35,000 feet. The other side of the cover plate is turned up for use above 35,000 feet in safety breathing or pressure breathing; this side has special markings on it.

THE REGULATOR BELOW 30,000 FEET. (Regular demand breathing.) Below 30,000 feet, you can use the pressure breathing regulator *just like* a regular demand regulator. The auto-mix lever, elbow adapter, etc. are all just the same. The only difference is that the emergency knob is on the front instead of on the side of the regulator. Used this way the pressure breathing regulator gives you oxygen or an air-oxygen mixture on demand. It will do that with a regular demand mask, like the A-14, *or* with a pressure breathing mask.


THAT EXTRA PRESSURE RAISES my CEILING!
PRESSURE DEMAND SYSTEM
400 psi
400 psi
THIS SYSTEM DELIVERS OXYGEN UNDER PRESSURE ABOVE 40,000 FEET
FLOW INDICATOR
PRESSURE GAGE
CHECK VALVES
PRESSURE BREATHING MASK
100 PERCENT OXYGEN POSITION
DILUTER CONTROL
(AUTO-MIX)
A-14
REGULATOR
NORMAL OXYGEN POSITION
CLIP
"STOP" FOR SETTING DIAL
(EACH CALIBRATION CAUSES A "CLICK" AS IT CONTACTS THIS ILLUMINATED TEAR DROP)

THE REGULATOR ABOVE 30,000 FEET. (Pressure breathing.)

1. *How It Works.* Above 30,000 feet you use the regulator for pressure breathing. As you turn the dial to the right, a spring pushes down the diaphragm. This opens a check-valve and allows a stream of oxygen to enter the regulator. The farther you turn the dial, the farther the spring pushes the diaphragm down, and the greater the flow pressure of oxygen. The oxygen flows to your mask during your inhalation. Your exhalation cuts off the flow to your mask. It does this because of the way in which the pressure breathing mask works. When you exhale, the pressure builds up in the mask; this closes a valve and causes a pressure to build up in the regulator, where it is greater than the tension of the spring pressing on the diaphragm. This stops the flow of oxygen until you inhale again and release the pressure. Used for pressure breathing, therefore, the regulator gives you 100 percent oxygen under pressure on demand, but you must use a pressure breathing mask.

2. *How To Use The Dial Control.*

a. For Safety Breathing. Even though pressure is not absolutely necessary up to 40,000 feet, you give yourself protection against possible inboard mask leaks and insure yourself 100 percent oxygen by using two inches of pressure between 30,000 and 40,000 feet. You do this by turning the dial setting from "NORMAL" to "SAFETY."

b. For Pressure Breathing.

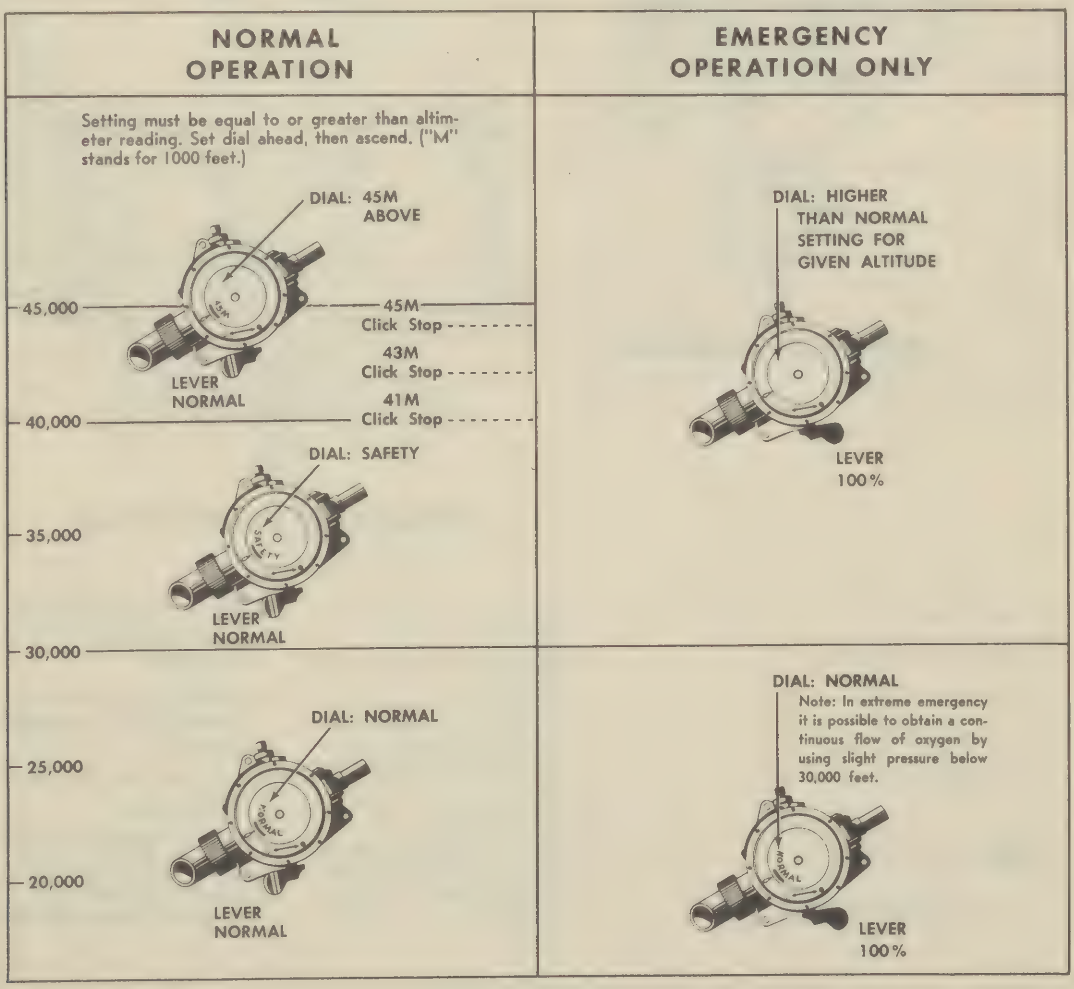
at 41,000 feet turn the dial setting to "41 M;"
at 43,000 feet turn the dial setting to "43 M;"
at 45,000 feet turn the dial setting to "45 M."

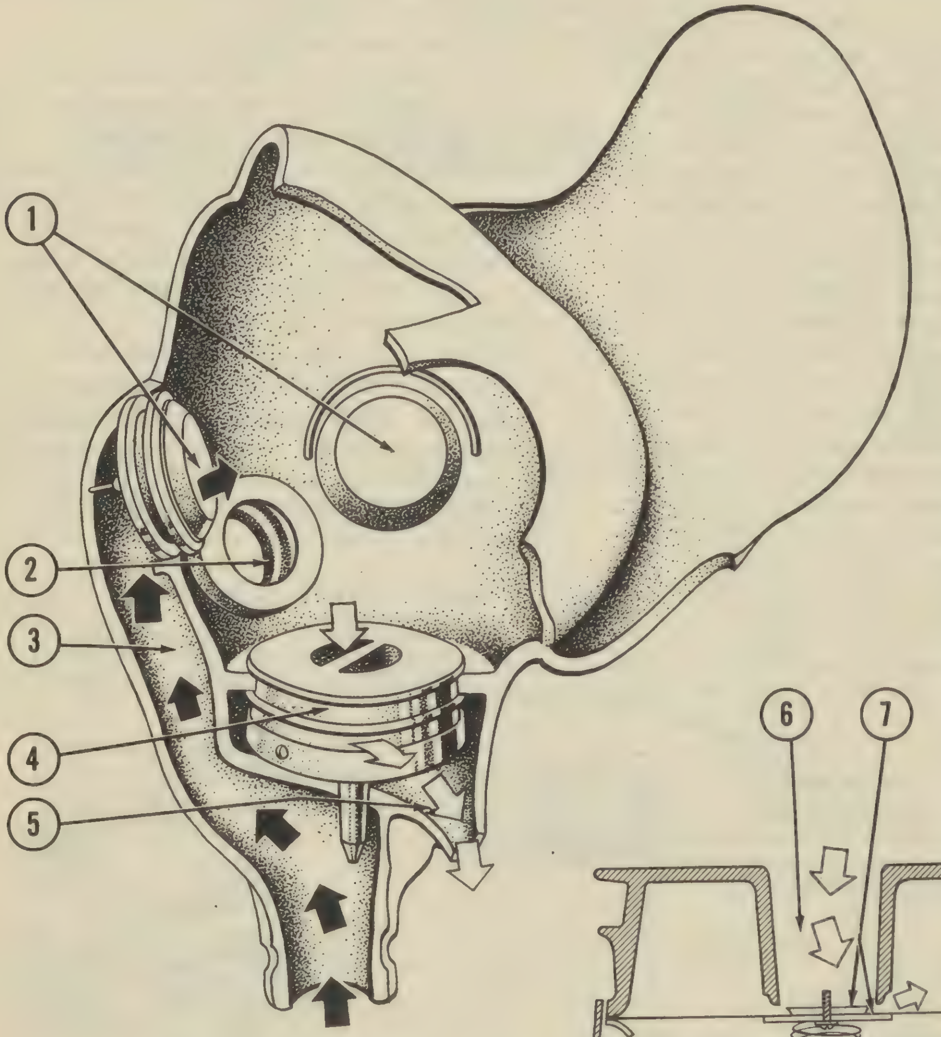
Remember, ascent above 43,000 feet is for emergencies only. If you have to go above 45,000 feet, turn the dial setting to "45 M ABOVE." There are "click stops" of the dial, between these marked dial settings, which represent 40,000, 42,000, and 44,000 feet; but it is best to use the marked dial stops.

Remember this: the dial setting must always be equal to or higher than your altimeter reading.

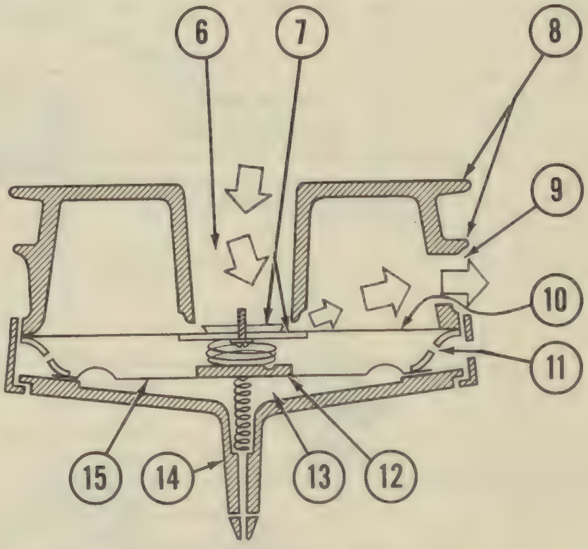
Don't use "safety" or pressure breathing below 30,000 feet. It wastes oxygen! It is the same whether you have the auto-mix lever on "100 PERCENT OXYGEN" or on "NORMAL OXYGEN" — when you use positive pressure the diluter is cut out and you get 100 percent oxygen.

TO SAVE OXYGEN KEEP THE AUTO-MIX LEVER ON "NORMAL OXYGEN" AND THE DIAL SETTING ON "NORMAL" AT ALL ALTITUDES BELOW 30,000 FEET.





PRESSURE-DEMAND MASK



EXHALATION VALVE DETAILS

1. Inlet Valves
2. Recess for Microphone
3. Inlet Port to Mask
4. Exhalation Valve
5. Outlet for Exhaled Air
6. Exhaled air enter exhalation valve here
7. These plates stiffen the main diaphragm
8. Projections on valve housing which seat in mask
9. Exhaled air leaves the valve here
10. Main diaphragm
11. This port permits pressure between the two diaphragms to equalize with the outside atmosphere.
12. This cup holds hairspring in place between the two diaphragms
13. Oxygen supply pressure is exerted in this "compensating" chamber
14. This tube sticks down into the mask inlet
15. This "compensating diaphragm" responds to oxygen supply pressure by pressing up against the main diaphragm

OXYGEN

EXHALED AIR

PRESSURE BREATHING AND THE BLINKER. When you use the pressure-breathing demand oxygen regulator without pressure, the blinker works the same way as it does with a regular demand oxygen regulator. The blinker does not work when you use safety pressure or pressure breathing.

THE MASK. The pressure-breathing mask (A-13 or A-15) is a very special type. You can use it instead of an ordinary demand mask with the regular demand oxygen system, and you have to use it for pressure breathing. You cannot use a regular demand mask for pressure breathing.

LOOK AT IT THIS WAY. Pressure breathing equipment can substitute for regular demand equipment—but—regular demand equipment cannot substitute for pressure breathing equipment.

HOW THE PRESSURE-BREATHING MASK WORKS.

1. *Below 30,000 feet,* when no positive pressure is being used, oxygen enters the mask through two one-way inlet ports. These have flapper-valves which close completely when you start to exhale. Exhaled air from your lungs passes out through the one-way exhalation valve in the floor of the mask. At the end of your exhalation, the exhalation valve closes off completely.

2. *Above 30,000 feet,* using safety or pressure breathing, the mask works the same way, except that the exhalation valve is now "loaded" or "weighted" with a pressure equal to that of the oxygen coming into the inlet ports. Therefore, in order to exhale, you have to breathe out with a pressure equal to the inlet pressure plus a little extra to open the "loaded" exhalation valve. This combined pressure is greater than the inlet pressure, so the pressure closes off the flapper valves of the inlet ports, and pressure builds up in the mask. The closed inlet valves cause the pressure to build up in the regulator, and the flow of oxygen stops until you inhale again. That is how you get 100 percent oxygen under pressure *and* "on demand."

HOW THE MASK FITS. Your Personal Equipment Officer or Flight Surgeon will help you fit the pressure breathing mask. The cheek flaps of the mask do not have to fit tightly, as they are mainly for protection against cold and flash-burns. *What is important* is the fit of the inside flap, which *must seal* all the way around.

The mask is suspended to the helmet by straps and snap fasteners. The straps should never be tighter than is just enough to "hold" the pressure. As you turn the regulator dial up and the pressure increases, you tighten the strap suspension just enough to hold the mask in place to prevent leaks.

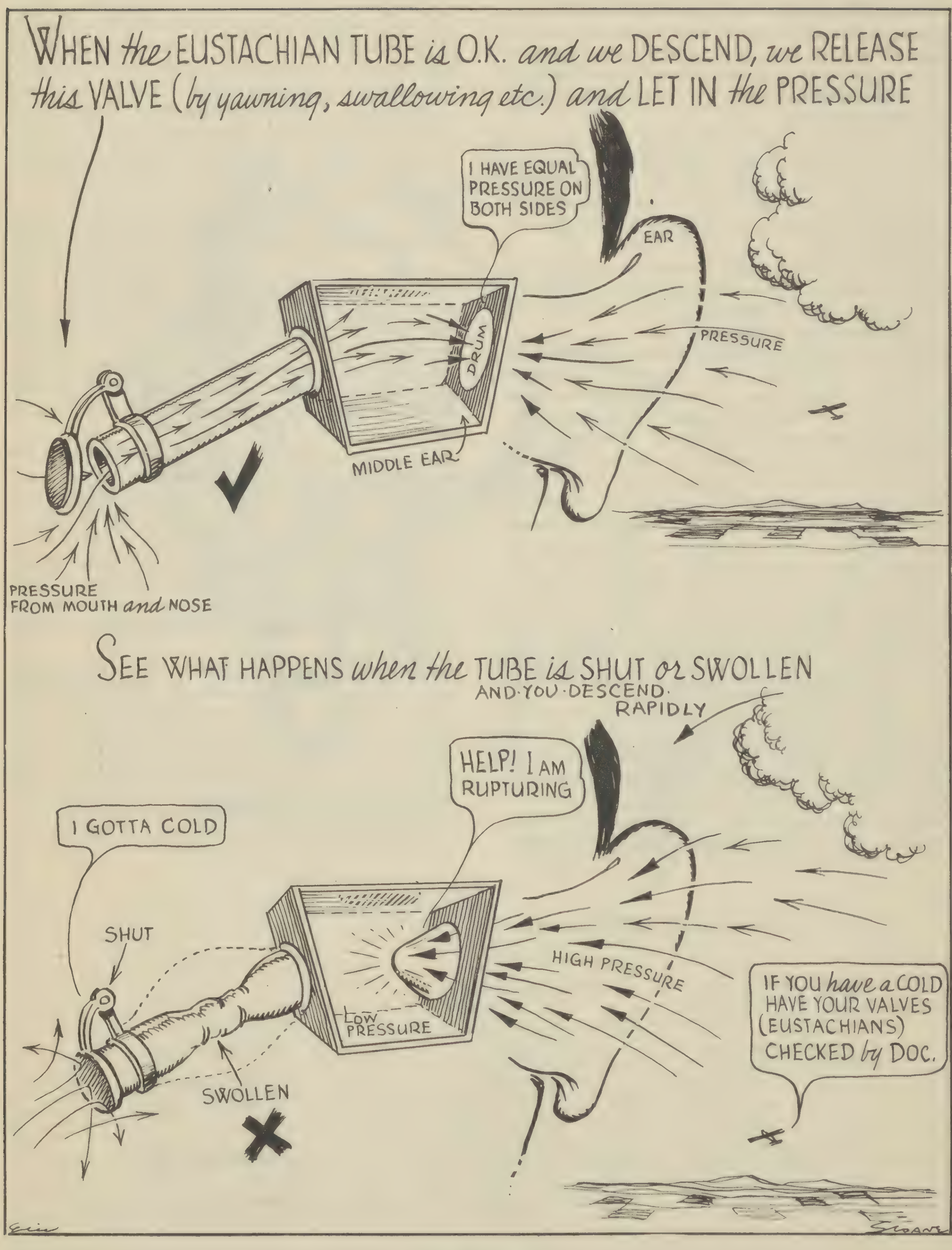
HOW TO CHECK THE MASK BEFORE FLIGHT. You *must* do these three quick, simple tests before flight:

1. Do a "suck" test—just as with the regular demand mask. But—with the pressure breathing mask the suck test not only tells you about the mask fit; it also tells you—and this is very important—that the exhalation valve is properly seated. If it is not properly seated, you will get a tremendous leak through it, and the suck test will not cause the mask to collapse on your face. The exhalation valve must be properly seated and must not leak.

2. Hook the mask up to the regulator, turn up the regulator dial to give you oxygen under pressure, and then hold your breath. Oxygen should stop flowing into the mask! If it keeps flowing, the exhalation valve is not functioning properly and should be replaced.

3. Now breathe with oxygen under pressure. If you can't exhale, one or both of the inlet check-valves is not seated properly, or the rubber is worn out. In the first case, it should be adjusted; in the second case, it should be replaced.

NOTE. Clean the mask periodically with a clean, moist cloth. If you have to remove the pressure-breathing mask at altitude, use the same technique as with the regular demand mask. While it is off your face oxygen will flow continually, but don't stop to turn the dial down, because the waste at that altitude (above 35,000 feet) in the 30 seconds or so that it's off your face will not amount to much. It is safest not to bother with the dial when you have to remove the mask at altitude.


WHEN the EUSTACHIAN TUBE is O.K. and we DESCEND, we RELEASE this VALVE (by yawning, swallowing etc.) and LET IN the PRESSURE
I HAVE EQUAL PRESSURE ON BOTH SIDES
EAR
DRUM
PRESSURE
MIDDLE EAR
PRESSURE FROM MOUTH and NOSE
SEE WHAT HAPPENS when the TUBE is SHUT or SWOLLEN
AND·YOU·DESCEND· RAPIDLY
HELP! I AM RUPTURING
I GOTTA COLD
SHUT
HIGH PRESSURE
LOW PRESSURE
SWOLLEN
IF YOU have a COLD HAVE YOUR VALVES (EUSTACHIANS) CHECKED by DOC.

SECTION 3

THE EAR, SINUSES, BELLY, AND BENDS

Pressure in the ear

TO BE A GOOD FLIER, KEEP YOUR EARS OPEN. Not only to hear the radio, the telephone, and engine sounds, but also to keep from being grounded with ear trouble.

WHERE THE TROUBLE ARISES. The trouble arises in the middle ear, an air-filled "box" behind the ear-drum. This "box" is completely walled off on *all* sides, except for a small opening in the front wall. The opening leads into a very narrow "relief" tube (Eustachian tube) which runs down into your throat. The tube and opening allow pressure to be equalized between the middle ear and the outside air as you gain or lose altitude. What causes the trouble is that the throat-end of the tube works like a flutter valve. Air can get *out* (going up to altitude the outside pressure falls) much more easily than it can get *in* (coming down from altitude the outside pressure increases).

GOING UP. The outside pressure drops and the air in the middle ear expands. At first this causes the ear-drum to bulge out a little, but then the surplus air slips into the "relief" tube and down to the throat. The ear-drum pops back into place and you feel a "click" in your ear. This will all happen by itself, but you can hasten it by swallowing as you ascend.

COMING DOWN. The outside pressure increases above the pressure in the middle ear and pushes the ear-drum in. Air tries to get from the throat into the "relief" tube, but usually can't because of that "flutter-valve." You have to open the "valve." You can do that by swallowing, or yawning, or blocking off your nose, closing your mouth, and blowing gently. The "valve" opens; air rushes into the middle ear to equalize the pressure; the ear-drum pops back into place; and you feel your ear clear.

WHEN THE TROUBLE ARISES. The trouble arises when you fly with a cold. A cold causes the membrane lining the inside of the "relief" tube to swell up. This blocks up the passage-way and makes it even more difficult for air to get through, especially *up* the tube into middle ear.

DON'T FLY WITH A COLD UNLESS IT IS ABSOLUTELY NECESSARY. IF IT IS, SEE YOUR FLIGHT SURGEON *BEFORE* AND *AFTER* THE FLIGHT.

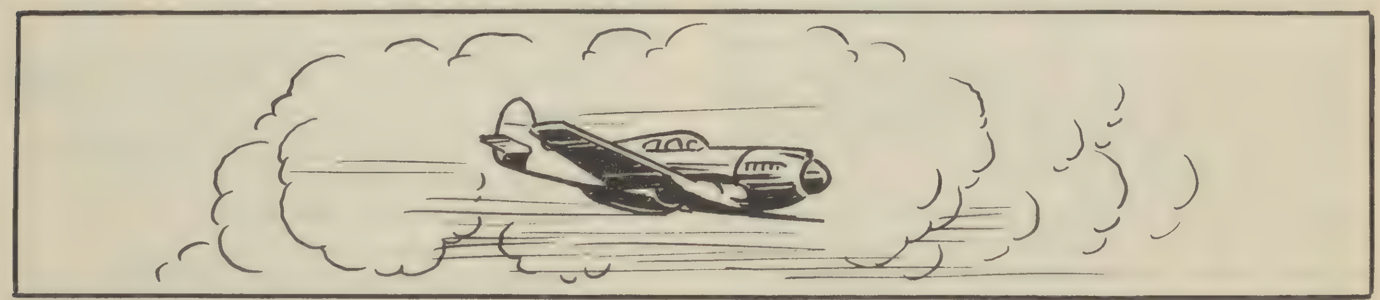
Before the flight: the flight surgeon can shrink that membrane down. He can also tell you how best to use a nasal inhaler to help clear your ears during the flight.

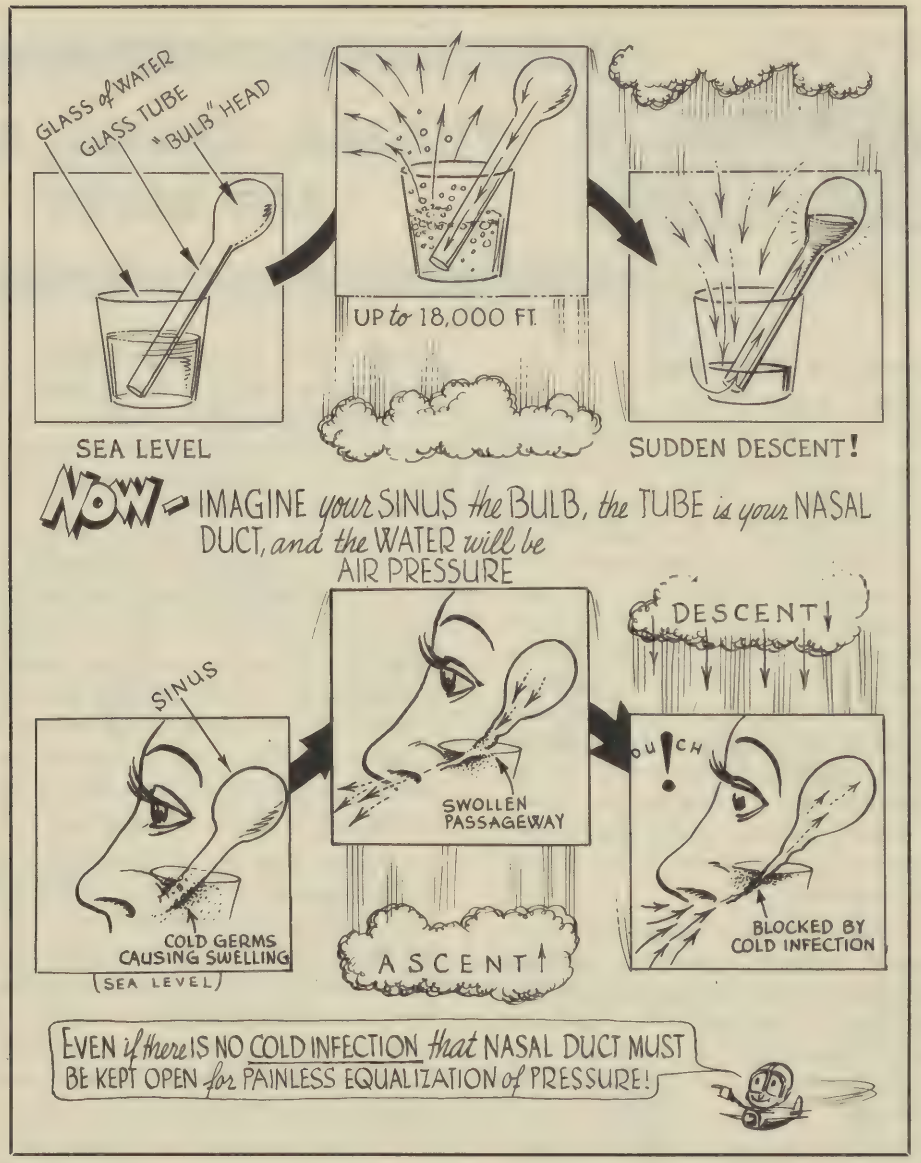
After the flight: the flight surgeon can blow air up into the middle ear, if necessary, to equalize pressure.

HOW TO AVOID TROUBLE.

1. *Clear your ears frequently during descent* as soon as the slightest amount of pressure appears. Don't wait until your ear is badly blocked. The longer you wait, the harder it will be to clear it!
2. *Climb back up a few hundred feet* if you can't get your ears cleared. It will be easier up there. Then come down slowly and keep clearing the ears.
3. *See your flight surgeon as soon as you land* if you haven't been able to clear your ears.
4. *Never fly with a cold* unless you have to—and then see your flight surgeon before and after flight.

WHAT THE TROUBLE DOES TO YOU. If you can't clear your ear during descent, the ear-drum gets pushed in by the outside pressure. This irritates the drum, which gets red and swollen, and may even rupture if you come down fast enough with a completely blocked ear. What you get out of it are pain and poor hearing. It may take you days to get over these; and a ruptured ear-drum may ground you for many weeks.





Pressure in the sinuses

THIS IS PRETTY MUCH LIKE THE EAR, except that it doesn't cause trouble nearly as often.

MEET YOUR SINUSES. A sinus is an air-filled space in the skull. The space is lined by a membrane and has a passage-way to the nose. You have many sinuses in your skull, but the only ones that ever cause trouble in flight are located just above your eyes and in your cheekbones As you go up or down and the outside pressure drops or increases, air passes out of or into the sinuses to equalize the pressure. This usually takes place very easily and without your thinking about it. Unlike the ear, though, if trouble does occur, it can do so in either direction—going up *or* coming down.

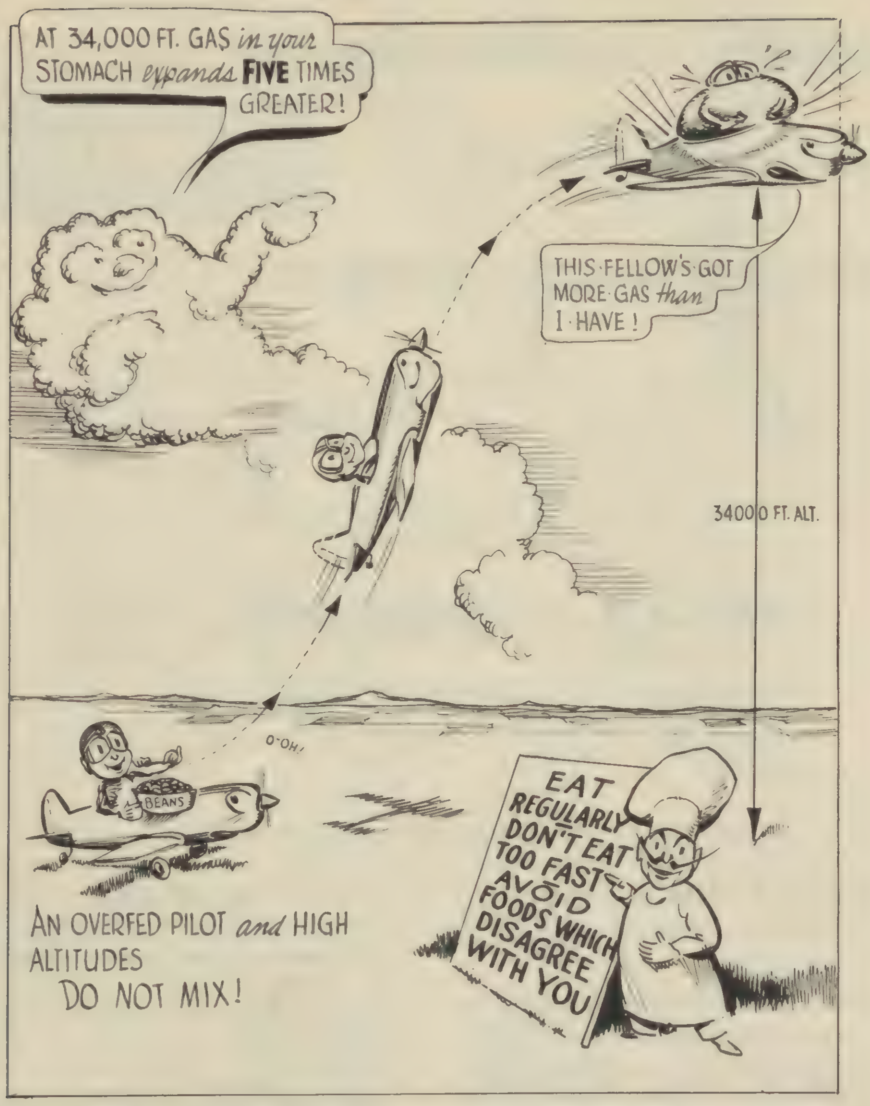
MEET THE VILLAIN. The villain—again—is a COLD. Colds may block up the passage-way from sinus to nose. You'll KNOW it when pressure can't be equalized, because the PAIN of a blocked sinus can be pretty terrific.

WHAT TO DO FOR A BLOCKED SINUS. If you get a blocked sinus, here is what you should do:

1. *Level off.* Better still, if you have been climbing, descend a few hundred feet; or if you've been coming down, go up.
2. *Clear your nose.* This can be done by "hawking" mucus back into your throat, or by blowing your nose. Try both ways. Use a nasal inhaler if you have one with you.
3. *See your Flight Surgeon* as soon as you land.

HOW TO AVOID A BLOCKED SINUS.

1. *Don't fly with a cold.* If you have to, see your Flight Surgeon before and after the flight.
2. Clear your nose thoroughly before take-off, and as thoroughly as you can before you start down.
3. Carry a nasal inhaler with you if
   your Flight Surgeon advises it.
   you have a tendency to an obstructed nose.
   you have ever had sinus trouble.



Your belly and the haystack

THE SMART FLIER keeps his tank, not his belly, full of gas. The picture of the flier with the balloon-belly looks comical, but it is *NOT* funny to have a pain in your middle while you are trying to out-maneuver a Jap Zero, operate your machine gun, or set your bomb sight.

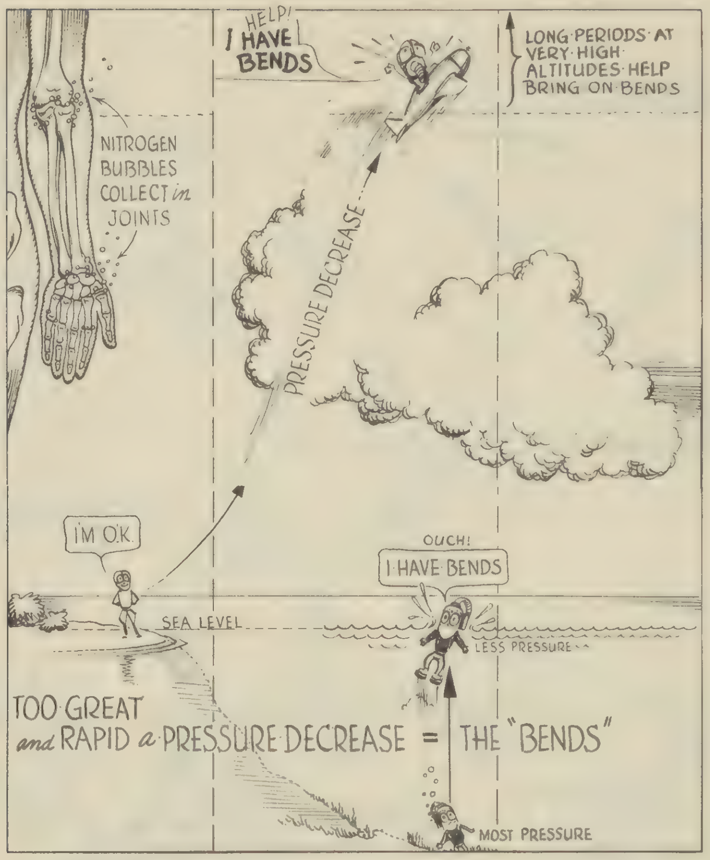
YOUR BELLY AT ALTITUDE. At the beginning of this book you learned about the "atmospheric haystack"—about how the air packs down tight near the ground, but thins out and *expands* more and more as you go higher and higher. Something like that happens to the gas in your stomach and bowels. As you go to altitude and the outside pressure falls, the gas in your bowels expands:

At 16,500 feet it is 2 times its sea level volume
At 25,000 feet it is 3 times its sea level volume
At 34,000 feet it is 5 times its sea level volume
At 39,000 feet it is 7 times its sea level volume

WHAT HAPPENS TO THE GAS. YOU would be a balloon-belly if you had no way of getting rid of the expanding gas. Ordinarily you can get quick relief by belching or passing the gas; this usually occurs when you reach 20,000 feet. If you don't or can't get rid of it, you may get pretty severe pain as you go higher. Sometimes moving around, even in your seat, will help you pass the gas. You won't have any trouble at all, though, if you eat and drink sensibly and keep fit.

HOW TO PREVENT TROUBLE.

1. Eat at regular times whenever possible and don't "bolt" food or "eat on the run."
2. Avoid any foods which you know to disagree with you.
3. Don't over-eat or miss a meal—one is just as bad as the other.
4. Avoid soda-pop, beer, and large amounts of water before going to altitude.
5. Don't chew gum during ascent. When you chew gum, you often can't help swallowing air, and this may give you trouble at altitude. If you want to chew gum to help clear your ears, do it when you start to come down.
6. Keep regular bowel habits—if possible, have a bowel movement before going to altitude.



Bends and the bottle of pop

The flier who goes to altitude is like a freshly opened bottle of pop!

THE BOTTLE OF POP. Carbon dioxide gas is forced into the fluid under pressure and the bottle is capped. With the cap on, high pressure keeps the gas hidden in solution. Take the cap off and the higher pressure of the gas inside the bottle starts to equalize with the lower pressure outside the bottle. With the pressure off, the gas comes out of solution and forms bubbles in the fluid.

YOU. The air you breathe (mostly nitrogen gas) goes into solution in your blood and body fluids. Nitrogen gas is kept hidden in solution by atmospheric pressure at ground level. Go to altitude and the outside pressure becomes less than the pressure inside your body. The pressures start to equalize. With the pressure off, the nitrogen gas comes out of solution and forms bubbles in your blood and body fluids.

WHAT HAPPENS TO THE BUBBLES. As you go to altitude, the circulation of your blood removes the excess nitrogen and even the bubbles from your body. On rare occasions in airplanes the bubbles are not carried off fast enough, and above 30,000 feet they may accumulate in your joints, lungs, or skin. If they do, they may cause:

Bends—pain in the joints or muscles
Chokes—pain in the chest, cough, and hard breathing
Creeps—hot or cold sensations in the skin

These things are pretty much the same as similar troubles experienced by deep-sea divers and "sand-hogs" who come up from below (from higher to lower pressure) too fast.

NOTE: When we speak of "bends" here, we mean "chokes," too. "Creeps" are a little annoying, but not painful or dangerous.

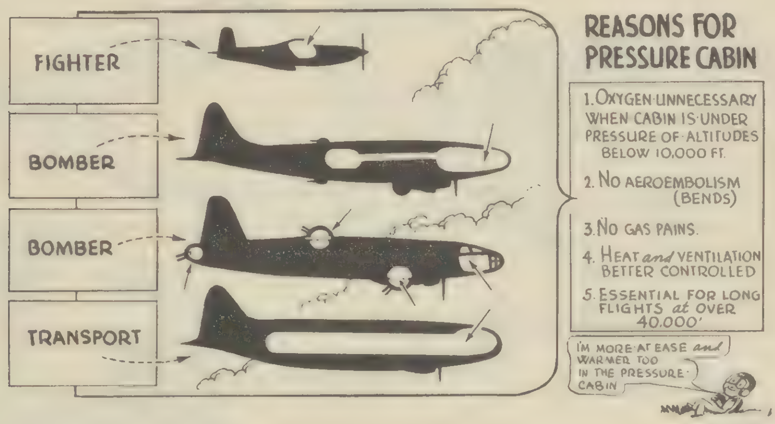
FACTORS WHICH HELP BRING ON "BENDS." "Bends" has not been a problem to date. Only very few fliers have had "bends" in aircraft, and some special factor or combination of factors has been responsible in these cases. The factors which help to bring on the bends are (1) long stays at very high altitude; (2) fast climb to altitude; (3) exercise at altitude; (4) older fliers; (5) fat fliers; and (6) fliers who have poor natural resistance to "bends."

RELIEF OF "BENDS." The only way to get sure relief from "bends" is to come down below 30,000 feet. Before you get down, though, it will help if you *do not* move the arm or leg that hurts. Rubbing or exercising it makes it worse!

PREVENTION OF BENDS. Bends can be prevented to a great extent by breathing 100 percent oxygen for 30 minutes (on the ground or at any altitude up to 20,000 feet) *before* getting to high altitude. This gets rid of the body's nitrogen gas, so no bubbles can form. It can be done by turning the auto-mix "OFF" ("100% OXYGEN"). It is never done except

for special high altitude missions.
on specific advice from your Flight Surgeon.

SECTION 4 CABIN IN THE SKY



Pressure breathing is not the only way in which a flier's ceiling can be raised. An even better way is to go farther than just "pressurizing the lungs," and pressurize the cabin instead. This is a better way because it affects not only the flier's lungs, but his entire body. The airplane may be flying at 30,000 feet, where the atmospheric pressure is very low, but the pressure inside the cabin may be kept much higher, so that the flier is actually sitting in an atmosphere equivalent to only 8,000 feet. In other words, pressure breathing brings the flier's lungs "down to a lower altitude," a pressure cabin brings all of his body "down."

Advantages of pressure cabins

1. In some planes, the flier can go to altitudes as high as 35,000 feet without using *any* oxygen equipment, and to even higher altitudes (over 40,000 feet) using "regular demand oxygen" instead of pressure breathing. In other planes, the flier may use "regular demand oxygen" at altitudes where he would ordinarily have to use pressure breathing.

2. Gas pains and bends are prevented or lessened.

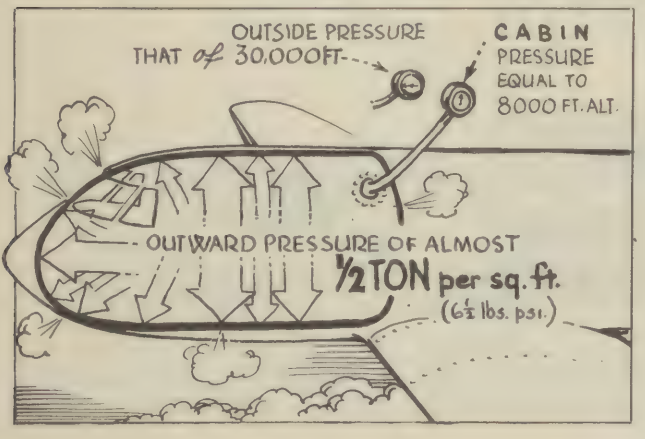
3. Heating and ventilation in the cabin can be better controlled.

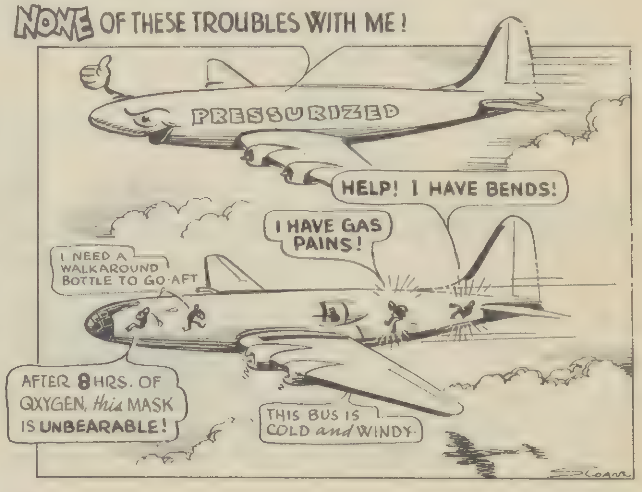
Disadvantages of pressure cabins

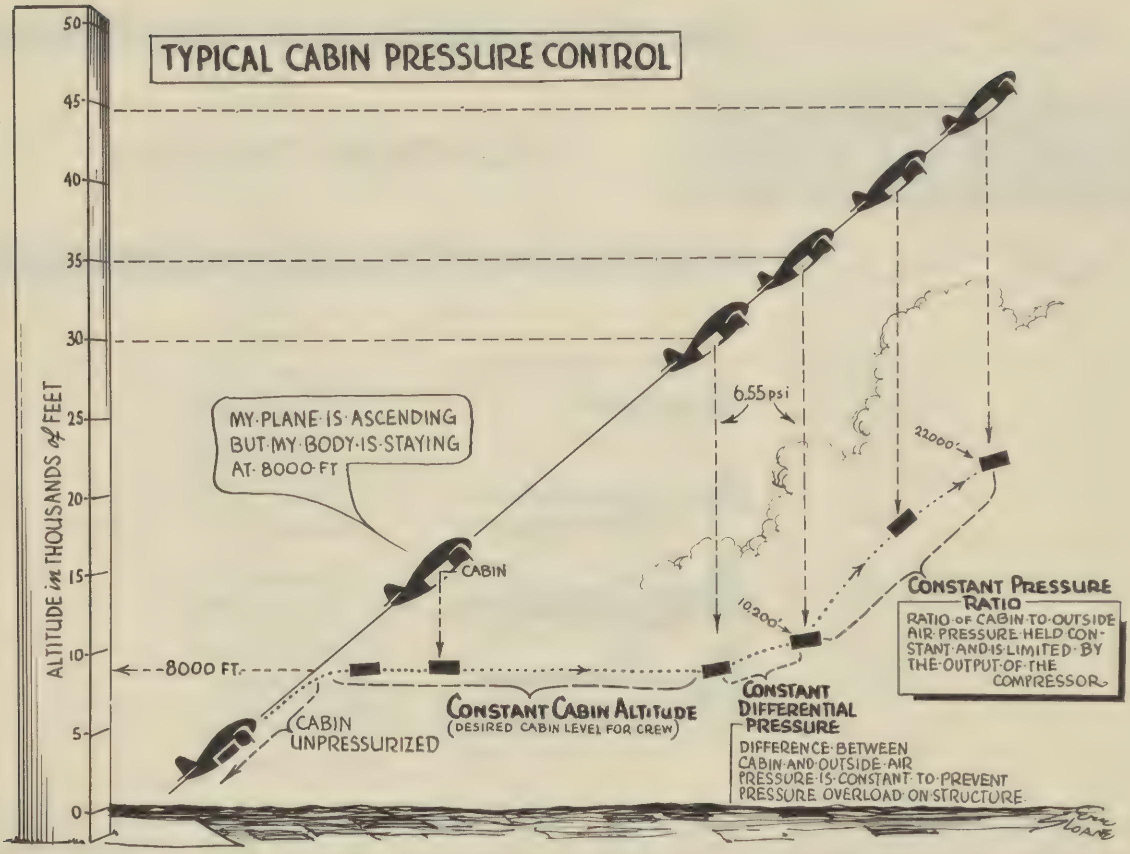
1. Extra equipment is necessary to maintain the pressure.

2. Bulk and weight have to be added to the plane to withstand the pressure.

3. Pressure can be lost through a hole made in the cabin by enemy gunfire.





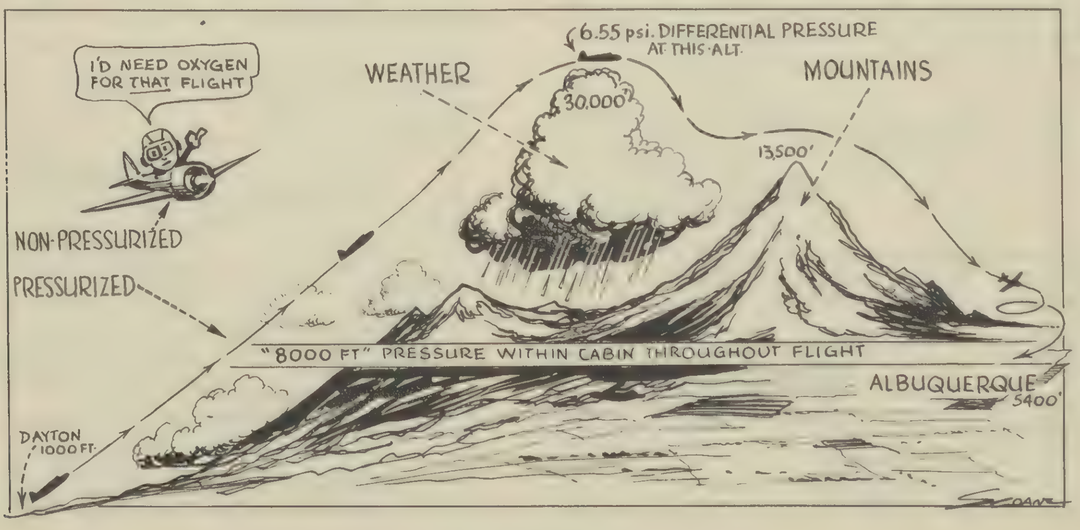


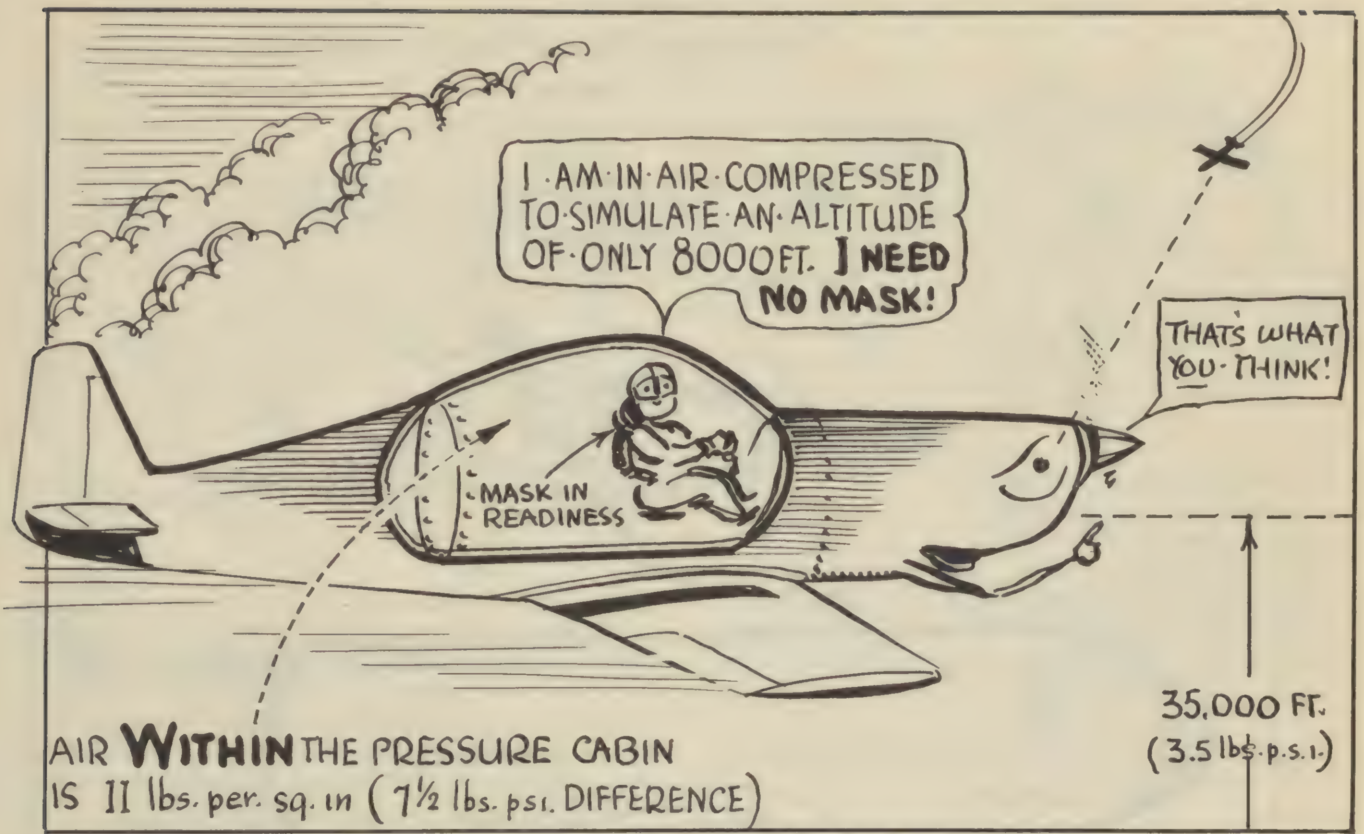
Pressure differential

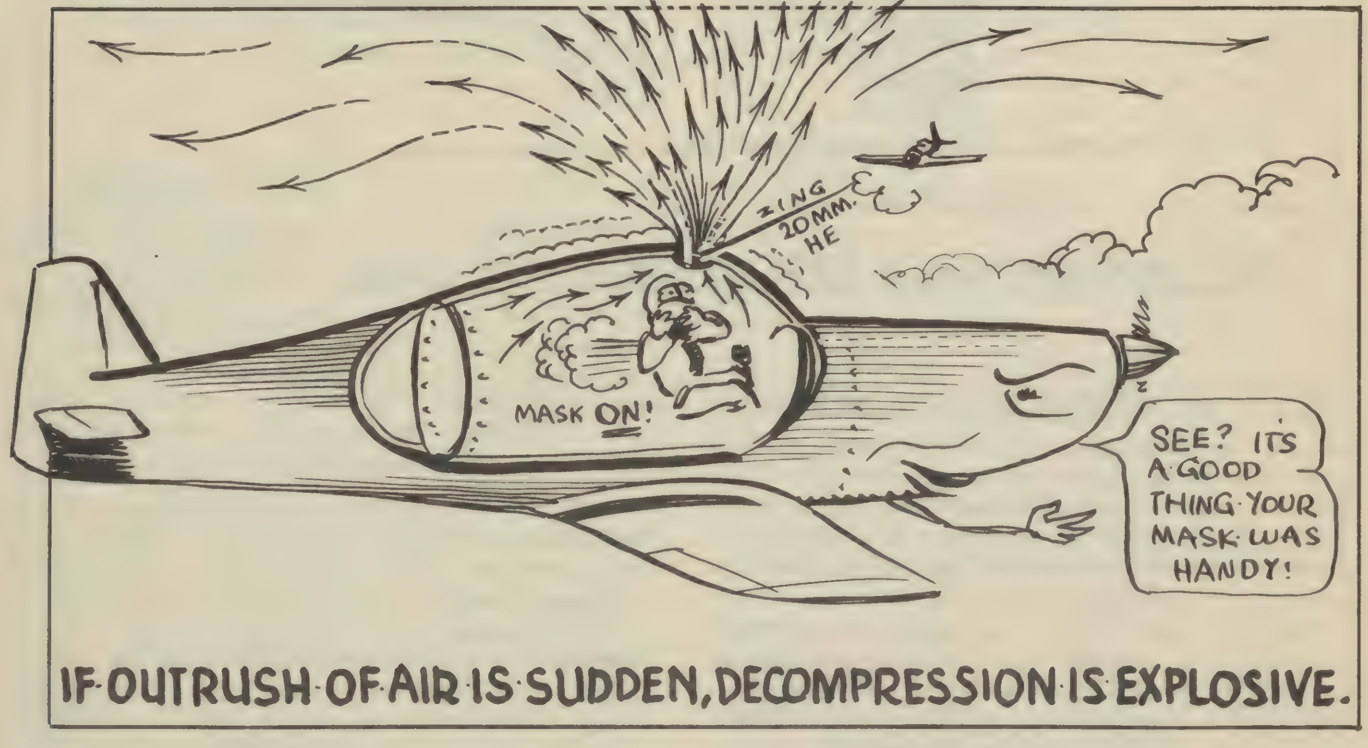
The "pressure differential" is simply the difference in pressure inside and outside of a pressurized cabin. This difference is measured in pounds per square inch (psi). Pressure differential in psi is the way we "rate" pressure cabin. At present, the Army Air Forces generally uses two levels of pressure differential:

1. *In bombers,* a pressure differential of 6.55 psi. This means that the flier is at an altitude of 8,000 feet when his plane is at an actual altitude of 30,000 feet; and that he is at 10,200 feet when his plane is at 35,000 feet. It means that he does not have to use oxygen up to about 35,000 feet; that he can use "regular demand oxygen" instead of pressure breathing at altitudes in excess of 40,000 feet; and that he will have no gas pains or bends even at altitudes much higher than that.

2. *In fighter ships,* a pressure differential of 2.75 psi. This pressure differential is not enough to allow the flier to go without extra oxygen to very high altitudes, but it does allow him to get along without pressure breathing at altitudes over 40,000 feet, and it prevents or reduces gas pains and bends.

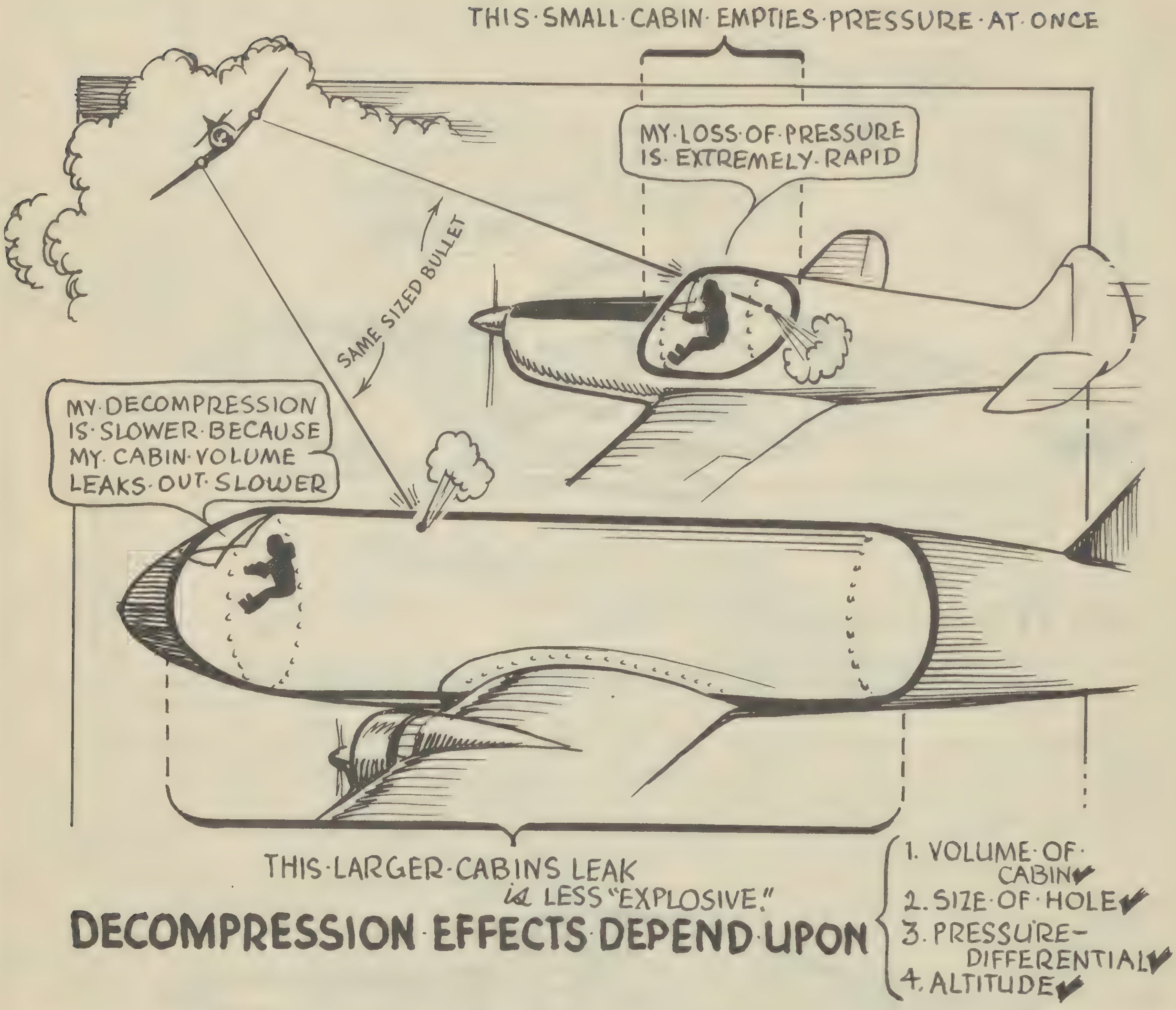






Gunfire and pressure cabins (Explosive decompression)

If an enemy shell puts a hole in your pressure cabin, the pressure inside the cabin will instantly become the same as the pressure outside the cabin. This sudden loss of pressure differential is called "explosive decompression." This does *not* mean that there is an explosion. What it amounts to is an "ascent" (in terms of pressure) of many thousands of feet in less than a second; this is so fast that we call it "explosive."



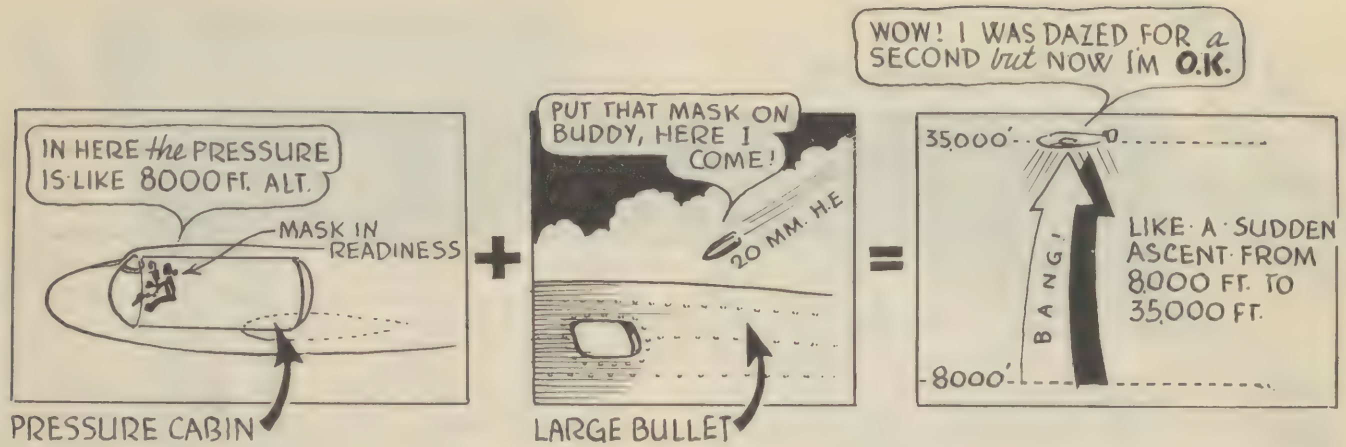
Effects of sudden loss of pressure

It was once thought that a sudden loss of pressure would have dangerous effects on the flier. We know now that with the pressure differentials used in Army Air Forces aircraft the flier need have no fear of explosive decompression as long as he has oxygen equipment available for immediate use.

The effects of explosive decompression on the flier depend to a great extent on the rate of decompression—on how fast pressure is lost. The rate at which pressure is lost depends on three things: (1) the pressure differential; (2) the size of the hole through which the pressure is lost; (3) the size (volume) of the pressure cabin. The rate of decompression *increases,* gets faster, if (1) the pressure differential is greater; (2) the hole is larger; (3) the pressure cabin is smaller.

The amount of expansion of internal body gases in decompression, another important factor, depends on the psi differential released—ascent in pressure altitude and the altitude. The expansion is greater, if: the altitude is higher; the pressure differential is greater.

A great many experiments have been done on human beings undergoing sudden loss of pressure. In one group of experiments, the subject underwent a loss of pressure differential which was equal to going from 10,200 feet to 35,000 feet in less than 1/10 of 1 second. This experiment was done more than 150 times (on different people), and there were *never* any bad effects. The pressure differential here was the same as that used in bombers—6.55 psi, and the decompression rate (87 psi per second) was the same as would be produced if the pressure cabin of 1,000 cu ft volume were ruptured with a 5-1/2 foot diameter hole. Other experiments have shown that there are no bad effects from the same rate of explosive decompression from 8,000 feet to 35,000 feet (7.5 psi) in a 1,000 cu ft bomber.



The rate was even greater (125 psi per second) in experiments done with a loss of 2.75 psi pressure differential through an 18 inch hole (used in fighter ships) at an altitude of 45,000 feet—and again there were no harmful effects, but there were symptoms to indicate that at this rate and altitude, the upper limit of safety was being approached. In new fighters equipped with bubble-type canopies which may be disintegrated completely by gunfire, leaving an opening approximately 26 inches in diameter, lower pressure differentials will be necessary. A 1.5 psi at 45,000 feet and a 1.0 psi at 50,000 feet have been proved safe; however, these pressures will protect against only oxygen lack and not bends.

The pause that decompresses

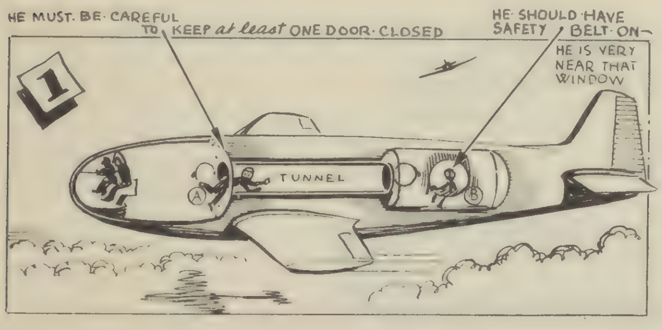
WHAT YOU FEEL IN A SUDDEN LOSS OF PRESSURE. You actually feel very little. You do *not* lose consciousness. You do not hear any noise. You are "dazed" for a lightning-like split second, and then you are fully alert and can put on your oxygen mask just as easily as though you were at 10,000 feet. It all happens so fast that it is over before you know it, and you have "felt" practically nothing.

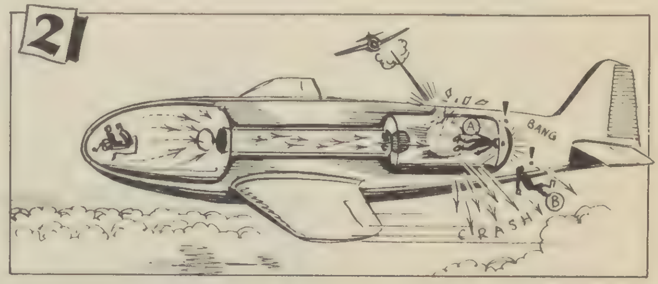
Your ears clear so automatically that you just don't feel anything there. Slight gas pains are very rare. In fact, aside from the lightning-like period of "daze," you feel nothing except a rushing of air out through your mouth and nose. This air comes from your lungs. When the pressure outside your chest suddenly gets less, the air in your lungs expands very suddenly and rushes out. You feel this rush of air, but it is not at all unpleasant.

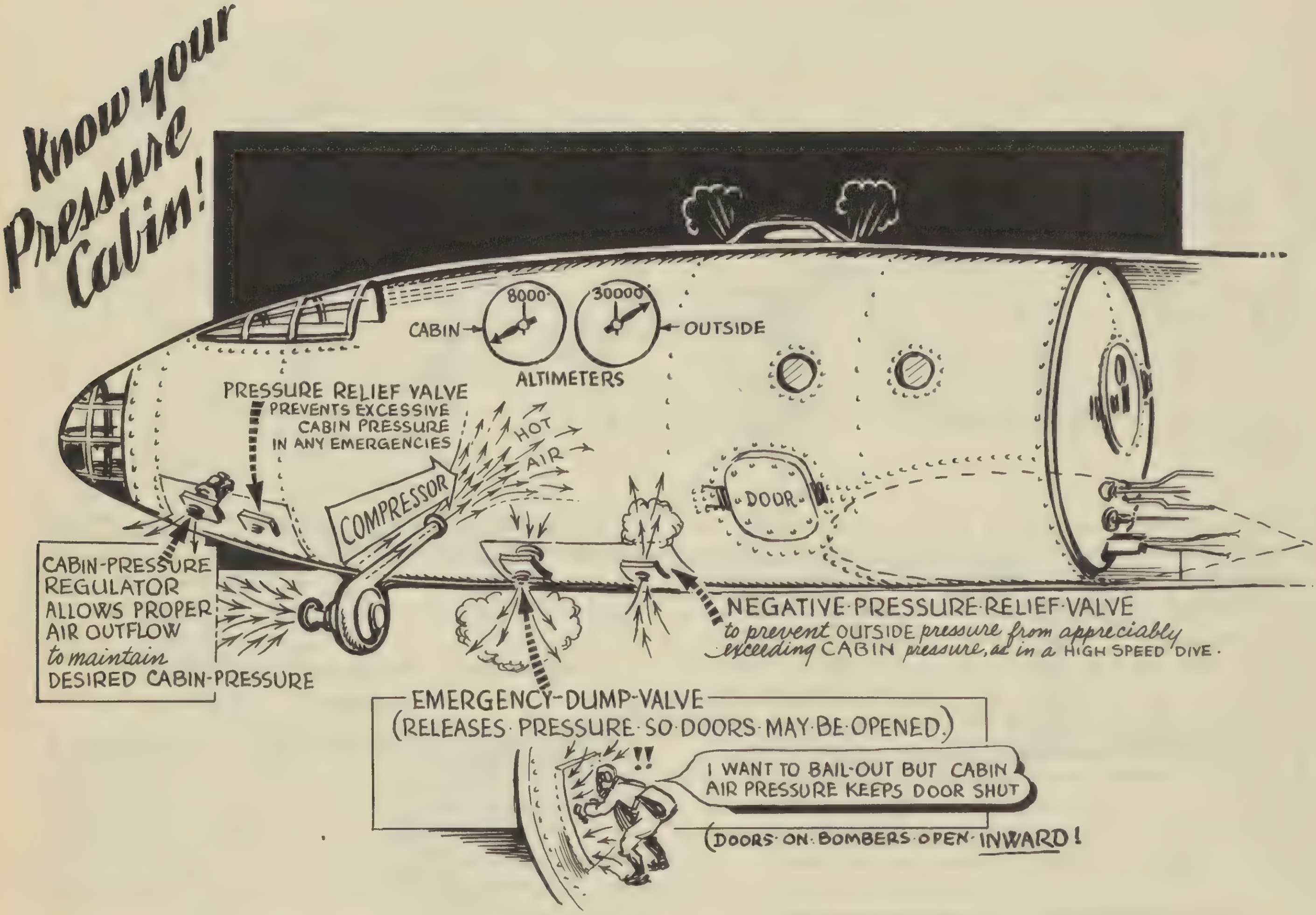
Explosive decompression and oxygen

Explosive decompression would be very dangerous if you didn't have oxygen right at hand, for you suddenly find yourself at "high altitude," where you would pass out in 30 seconds or less without oxygen. The flier in a pressure cabin must always have his mask right with him. It is best to keep it attached to the left side of the helmet, ready for use.

The kind of oxygen equipment you need in a pressure cabin depends on the altitude at which you fly and on the pressure differential. In a pressure cabin with a pressure differential of 6.55 psi, you would need regular demand oxygen equipment at altitudes above 35,000 feet. Over 40,000 feet, pressure breathing equipment would have to be available, in case of sudden loss of pressure due to enemy gunfire. Therefore, the flier in such a pressure cabin would have pressure breathing equipment with him. He would not use this at all up to 35,000 feet. Above that altitude, he would use it without pressure—as regular demand oxygen equipment. In case of a sudden loss of pressure above 40,000 feet he would use it with pressure.







Precautions to take in pressure cabins

These precautions must be taken for complete safety against the possibility of sudden loss of pressure:

1. Do not use greater pressure differentials than directed—especially in combat.

2. Always have oxygen equipment immediately available—keep your mask attached to your helmet.

3. For altitudes above 40,000 feet, have pressure breathing equipment available.

4. Heavy flying clothing or electrically heated clothing should be with you in the ship. In the event of a hole in the pressure cabin, there will be a drop in temperature.

SECTION 5

B-R-R-R-R!

Global operations mean, among other things, global temperatures. For example, an assignment ordering you to proceed from Moffet Field, California, to Ladd Field, Alaska, might read, if it were translated into temperatures:

> Proceed from a region with a ground temperature of 122° F to one with a ground temperature of *minus* 50° F.

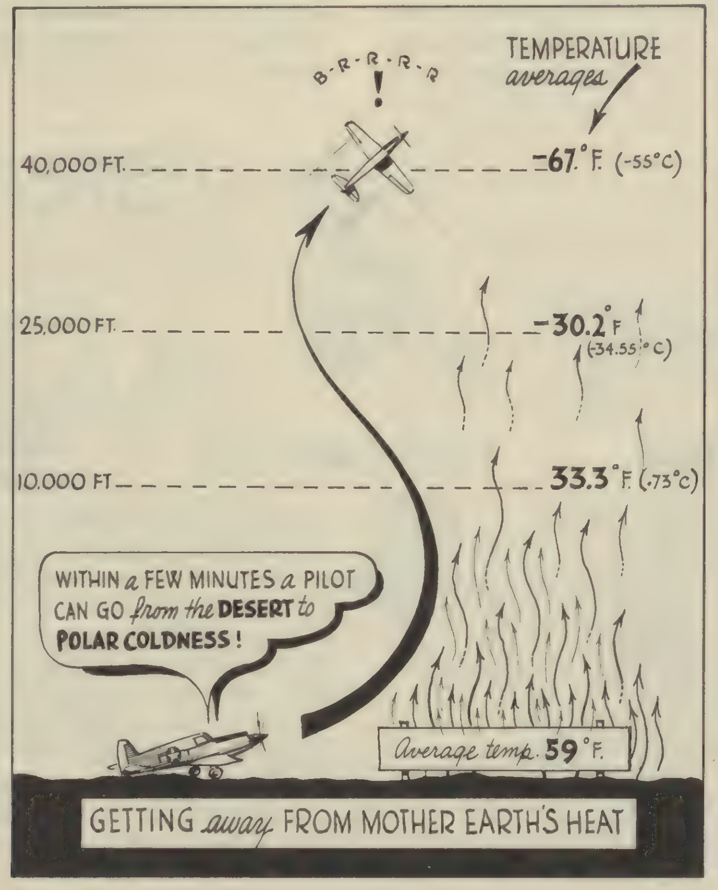
As you are a flier, however, you may have to undergo even greater changes than that, and in a much shorter period of time. For instance, let's do some temperature translating for a mission in a desert theatre of operations:

> Take off from a ground temperature of 120° F to a temperature at 35,000 feet of *minus* 67° F.

Nature has equipped your body with an automatic heating and cooling system which keeps you comfortable within a very limited range of temperature. This range of comfort is marked, like a thermostat, at the lower level by shivering and at the upper end by sweating. One of the flier's big problems is the quick change from the sweating to the shivering level. In addition, the flier at altitude goes much beyond the mere shivering level. The temperatures he meets at high altitudes are not only far beyond the range of his body's automatic heating and cooling system: they are actually dangerous, so that if he is not properly protected he may suffer severe frostbite.

There are four things which you as a flier should know if you want to protect yourself against the cold at high altitude:

1. KNOW what temperatures you will have to contend with;
2. KNOW how to reduce heat loss, which is what makes you cold;
3. KNOW your flying clothing—when and how to use it, and how to take care of it;
4. KNOW how to prevent frostbite, and how to take care of it in the air, should it occur.



You get cold because you lose heat

You are a furnace.

You've probably never thought of yourself that way before, but it's true, for you produce heat. What is more, you produce it all the time—even when you are at rest. You can increase your heat production by exercising, which is simply a method of burning fuel faster. Shivering is involuntary exercise to which your body's thermostat resorts when more heat is needed.

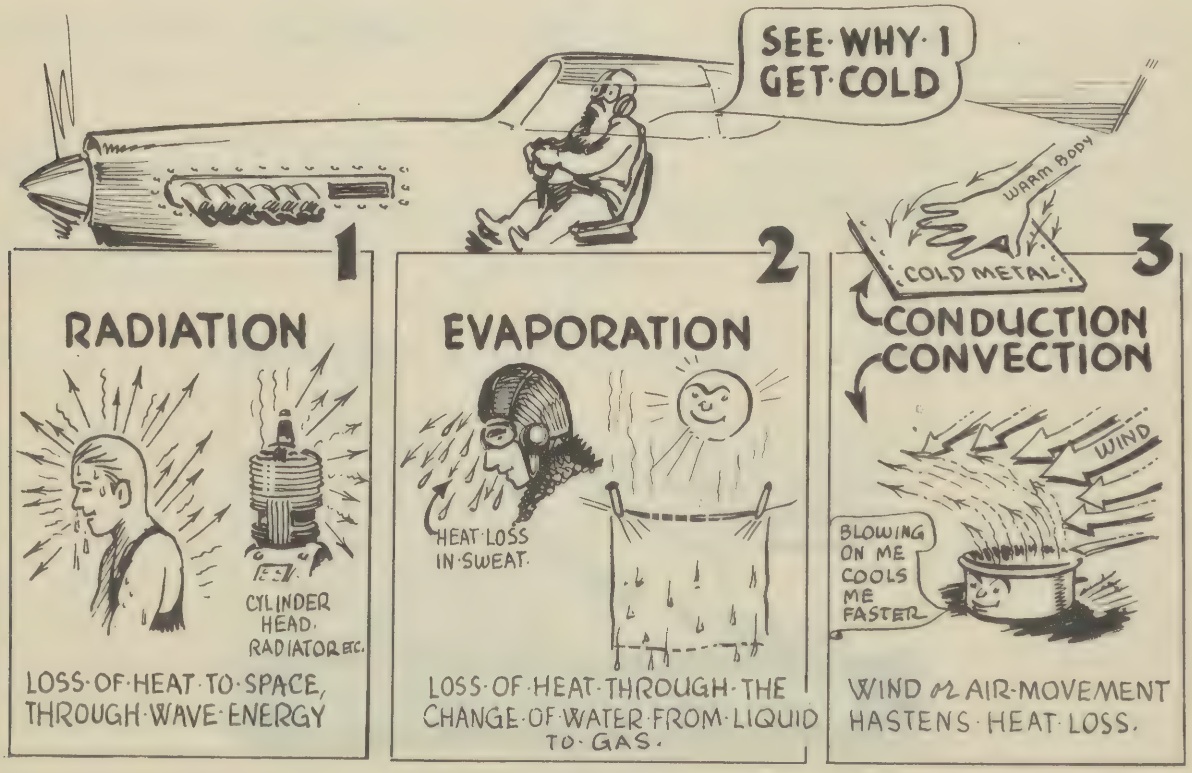
You also lose heat all the time, for heat always tends to escape. Heat loss is very important because it is why you get cold. Cold is not a positive force, but only an absence of heat! You get cold because you lose too much of the heat which your body, a food-burning furnace, continually produces. Your automatic thermostat tries to keep you in "heat balance" all the time, by regulating your heat production and your heat loss. It fails and needs your help when the outside temperature gets too low and heat loss becomes greater than heat production.

You can help in two ways: (1) by cutting down on heat loss, or (2) by supplying extra heat to your body from outside. In order to cut down on heat loss, you have to know more about how heat is lost.

HOW YOU LOSE HEAT. The body has three main methods of losing heat. While you're on the ground and not exposed to extreme temperatures, these methods of losing heat need not concern you. Normal changes of clothing and your body's ability to regulate its temperature within limits are adequate to maintain safety and comfort. At high altitudes, you are interested in hoarding every bit of heat you can, for the more you lose, the colder you'll be. So let us examine the three methods of heat loss and ways of reducing heat loss to a minimum.

1. RADIATION. A hot object—like a flat iron or steam radiator—gives off "heat rays" or "waves" called "radiation." Your skin is usually hotter than its surroundings, and hence radiates heat. When the body needs to keep all the heat it can, less warm blood tends to flow near the surface of your skin, skin temperature is reduced, and "radiation loss" is reduced. Clothing also helps reduce this loss by absorbing the heat waves and reducing the passage of heat away from the body. The thicker the clothing, the more effective it is.

2. CONVECTION. A hot object naturally warms the air around it. If the air is in motion, the hot air moves away, cooler air comes in contact with the object, absorbs more heat and carries it away. The faster air moves over your skin, the faster heat is carried away. Clothing reduces this loss by trapping warm air. Here again, the thicker the clothing, the greater is the layer of trapped air, and the greater is the reduction in heat loss. Several layers of thin clothing are better than one thick one, because in this way air is trapped between layers as well as next to the body. You can also help to prevent this kind of heat loss by staying where there is least air movement. *It is important to remember that the insulating value of clothing is greatly reduced if the clothing gets damp or wet*—either from sweat or outside moisture. Water fills up the air spaces, helps to conduct heat away from the body, and greatly increases the rate of heat loss through evaporation, which is described briefly in the next paragraph.

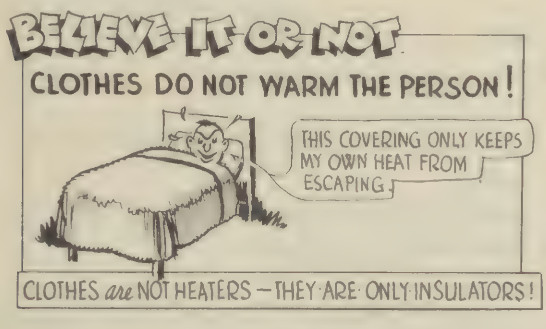


3. EVAPORATION. If you take a wet towel and swing it in the air a few times, it will feel cool. That's because the water which has evaporated has had a cooling effect—has taken heat away from the towel. The surfaces of your body which are normally moist—your eyes, lungs, and some parts of your skin—lose heat by evaporation in the same way. Sweating simply speeds up this process by creating more moisture on your skin surfaces. If the air around you is dry and moving, it takes away heat faster. If your body needs to conserve heat, it automatically cuts down surface moisture and reduces this evaporation loss to a minimum. Sweating while you are wearing heavy clothing is bad business: it dampens the clothing, reduces the clothing's insulation value, speeds up heat loss.

NOTE: *Your hands and feet need special attention at altitude.* In the first place, they are farthest away from the heart (the pump for your central heating plant). If for any reason your blood circulation is reduced, your hands and feet suffer first. Second, they have proportionately larger surfaces in relation to their size. They can lose heat by radiation, convection, or evaporation more quickly than other parts of the body.

How to keep warm at altitude

Cabin heating is the ideal solution for the flying warmth problem. It has proven pretty reliable up to 30,000 feet in fighter ships, but it is a much more difficult problem in bombers, especially for the protection of gunners in the waist, tail, and ball turret. The members of an air crew must depend upon clothing for protection against the cold. Except for electrically-heated clothing, which actually gives off heat, clothing does not warm you; it keeps you from losing heat!



Polar wear

Standard heavy or intermediate flying clothing, made of shearling or alpaca, keeps you warm by preventing heat loss. Its most important functions are to insulate, or prevent conduction, and to trap air, or prevent convection. It does both of these more successfully and also cuts down more effectively on heat loss by radiation if several layers of clothing are used. The heavier the clothing, the better the insulation—but it cannot be too thick because it would interfere with moving around. Regular heavy flying clothing has a big advantage over the electrically heated suit in flights over Arctic regions, for it gives the flier protection on the ground in the event of a forced landing.

Proper use and care of clothing

In the long run, the protection you get from your clothing depends on how you use it and how you take care of it. Here are the important things you must know and do:

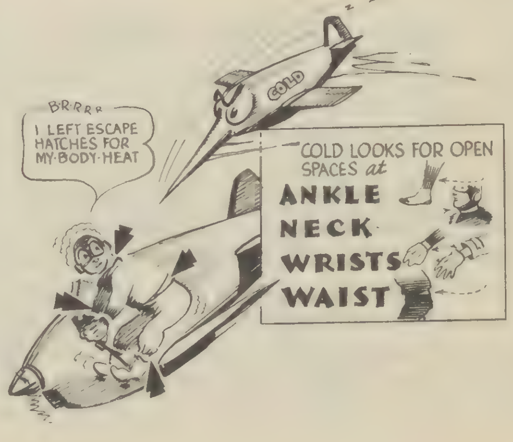
1. KEEP IT DRY. Keep clothing as dry as possible. If your flying clothes are wet or damp, they will be less insulating and a great deal of heat will be lost through the evaporation of the water in the clothes. The flier who puts on his heavy flying clothes on the ground in a warm climate and runs around in them is going to sweat on the ground—and then *freeze* at altitude. Remember the sequence: sweat, wet, and then freeze. *Watch out for that!*

2. FIT IT LOOSELY. A tight fit reduces the insulating value of clothing. Too tight *or* too large a fit makes it difficult to move around easily. The important thing is to get a loose, but not a "floppy" fit.

3. KEEP IT CLOSED. Complete closure of all open spaces is very important. See that there are no "leaks" in your flying clothes: that there are *no gaps* between the trousers and jacket, or between the trouser legs and your shoes, or around your neck. Good closure at the neck, waist, wrists, and ankles prevents cold air from coming in, or warm air from going out.

4. KEEP IT CLEAN. Oil, grease, or dirt cuts down on the insulating value of clothing. Keep those clothes clean if you want them to keep you warm!

5. BACK IT UP. You must wear heavy underwear under your heavy flying clothes for protection against extremely low temperatures.



Footgear

Dampness is one of the worst hazards to the feet at altitude. Perspiration or wet socks can give you cold feet, and even frostbite, even though you are wearing the right footgear. Always wear dry, woolen socks under your boots. Felt boots with leather soles are good outside footwear for protection against the cold, but the best all-around footgear at present is the leather, sheepskin-lined (A-6) boot. Heavy wool socks are worn underneath either type of footgear.

Gloves

Your hands are your weak spots in the sub-zero temperatures at altitude. You must take special care of your hands in the cold. The best way to start that is by practicing on the ground, with your heavy gloves on, all the things you may have to do with your hands at altitude. DON'T TAKE OFF YOUR GLOVES AT ALTITUDE. If you are well practiced, you will be able to do most things with your gloves on, and thereby avoid frostbite. The high altitude flier should be able to do as much with his gloves on as the ordinary man would be able to do with bare hands. Tests have shown that with practice, you can field strip a gun as quickly with gloves on as with your bare hands. Make that your goal!

The size of your gloves is very important, so you should be very critical about the fit you get. Too small a size reduces the insulation given by the gloves and cuts down on your manual dexterity. Too large a size also makes it awkward to do things with your hands. The trick is to get a loose fit, but not so loose that it will make it hard for you to do things with your hands.

The flier must wear thin rayon or silk glove inserts under all gloves. It gives better insulation, and if some special emergency compels you to remove the outer glove for a moment, you still have some protection from the glove insert.

Iced pans

The latest assembly of mask, goggles, and helmet gives the flier good protection for his face. In addition, a face and neck protector is provided for the crew member who is in an exposed position, such as at an open waist window.

Amps in your pants

Electrically-heated flying clothing keeps you warm by supplying your body with extra heat from outside, rather than by preventing heat loss. Its main advantages are that (1) it does not depend on bulk to keep you warm, so it is not cumbersome and you are allowed free movement; and (2) it keeps your hands and feet warm much more easily than does standard heavy flying equipment.

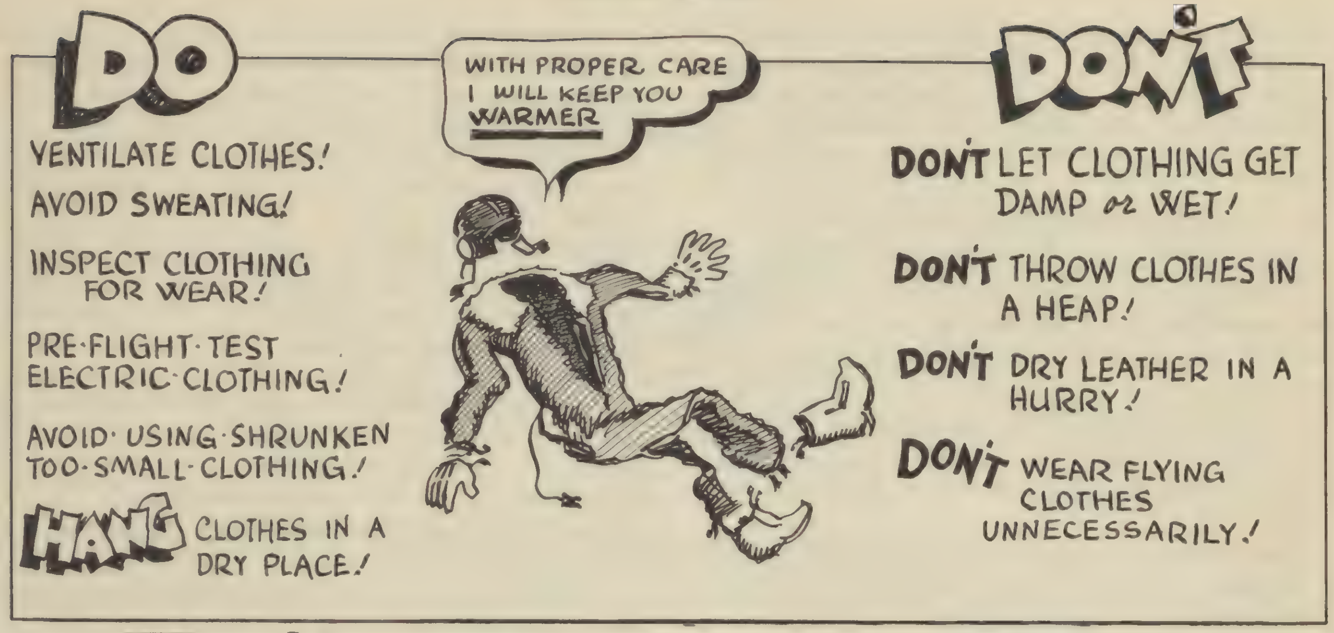
Its main disadvantage is that it is dependent on the power circuit of the ship. If there is power failure, or the circuit is shot away in combat, or a forced landing is made in Arctic regions, the flier is not as well protected as with the regular heavy flying suit. The later electrically-heated suits have remedied this somewhat, however. For instance, wearing an F-3 suit without electrical power you can withstand a temperature of *minus* 40° F with no wind for about an hour; you can do the same for about half an hour with the F-2 or F-2A suit. To be on the safe side, though, every flier should carry along heavy winter flying clothes, including boots and gloves, on all missions. Even though they might not seem necessary, you will need them if your electrically-heated equipment fails.

TYPES OF ELECTRICALLY-HEATED SUITS.

Three types are now in use: the F-2, F-2A, and F-3. The F-2 and F-2A consist of a two-piece removable liner carrying the heating elements, and a wool elastique covering. Wearing a heavy flying suit instead of the elastique over the liner gives better protection in the event of power failure. It is best for the flier to wear the suit as is, however, and to take heavy flying clothes with him for an emergency. The only difference between the F-2 and F-2A suits is that the heat supply in the F-2A is controlled automatically by hidden thermostats if you turn the rheostat to "HIGH" or plug into the place marked "24 VOLTS." The F-3 suit has no elastique covering. It is just a two-piece liner carrying the heating elements; one piece is a trouser-overall and the other, worn over the overall, is a jacket. The F-3 suit is worn over an ordinary uniform and under the intermediate (alpaca) flying suit.

HOW TO DRESS ELECTRICALLY. Here is how you dress if you wear an electrically-heated suit:

1. *Under the suit you wear:*
   - *a.* one suit of heavy woolen underwear;
   - *b.* two pair of light or one pair of heavy wool socks;
   - *c.* woolen shirt and trousers (with the F-3 suit), or just woolen shirt (with the F-2 or F-2A suit);
   - *d.* rayon or silk glove liners.
2. *The suit consists of:*
   - *a.* plain (F-2) or overall (F-3) trousers;
   - *b.* jacket;
   - *c.* electrically-heated shoe inserts;
   - *d.* electrically-heated gloves.
3. *Over the F-2 or F-2A suit you wear:*
   - *a.* one pair of heavy wool socks over electrically-heated shoe inserts;
   - *b.* fleece-lined or felt boots;
   - *c.* scarf inside jacket;
   - *d.* heavy flying clothing as needed, including a pair of fleece-lined gloves.
4. *Over the F-3 suit you wear:*
   - *a.* one pair of heavy wool socks over electrically-heated shoe inserts;
   - *b.* fleece-lined or felt boots;
   - *c.* intermediate alpaca trousers and jacket with scarf;
   - *d.* fleece-lined gloves;
   - *e.* face and neck protector for crew members in exposed positions.



CHECK YOUR CONNECTIONS BEFORE EACH FLIGHT. You must always be certain that all your connections are made, and that your extension cord is present. Check these carefully before every flight:

1. snap connections between shoes and trousers;

2. electrical connection between jacket and trousers—on right side;

3. snap connections between sleeves and gloves;

4. pigtail from jacket connects with a 6-foot extension cord which connects in turn with the rheostat.

DO'S AND DON'T'S WITH ELECTRICALLY-HEATED CLOTHING.

Do

1. Carry heavy winter flying clothing along on all missions.

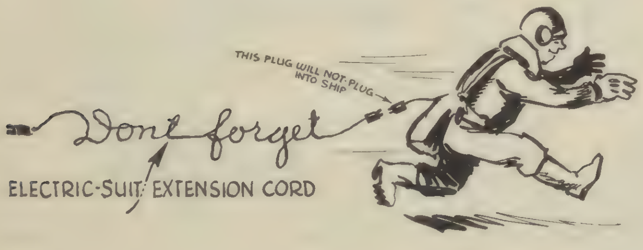
2. Take the best possible care of your clothing—hang it up to dry after each mission.

3. Wear *clean* underclothing, socks, and flying clothing. Dirt, grease, oil, etc. cut down on insulating value of clothing.

4. Be critical about fit—wear loose clothes.

5. Wipe all perspiration from your body before getting dressed.

6. Preflight check your clothing and connections before every mission.



Don't

1. DON'T use your flying suit for any purpose but flying! That means you do not use it to sleep in, or to work around the flight line, or while you do anything else on the ground. Take it off and hang it up as soon as you land, and do not put it on until you are ready to preflight check it before a flight.

2. DON'T roll the suit into a ball or throw it over a chair—hang it up!

3. DON'T run around or do anything to make you sweat before going "upstairs." "Sweat" means "wet," and "wet" means you freeze up there.

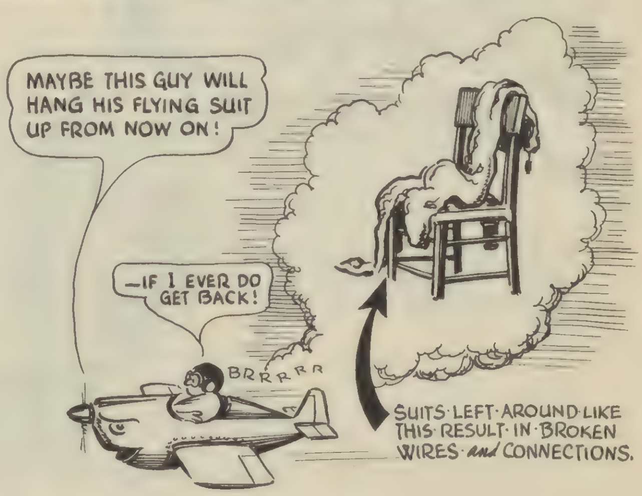
4. DON'T wear wet or damp underclothes,socks, etc.

5. DON'T fly "hot." Keep your rheostat down at the lowest possible setting for comfort.

6. DON'T wear tight clothing anywhere on your body.

7. DON'T remove your gloves at altitude, or the face and neck protector if you are in an exposed position—frostbite comes on fast!

8. DON'T make repairs of electrically-heated clothing yourself—let your Personal Equipment Officer attend to that; that's what he's there for.



PREFLIGHT CHECKS OF ELECTRICALLY-HEATED FLYING CLOTHING. Do this check before every mission. If you take care of your clothes and do preflight checks, you will not have trouble at altitude. Electrically-heated equipment is good—if you use it intelligently.

1. Check *all* connections and extension cord.

2. Plug into socket marked "HEATED CLOTHING."

3. Turn rheostat on full. In three or four minutes you should feel heat, especially on the back of your hand, on your thigh, on your chest, and on the ball of your foot.

4. If you feel heat in all these places, your suit is o.k.

5. If you do not feel heat and all the connections look o.k., have your suit replaced by the Personal Equipment Officer.

Apart from power failure and forced landings in Arctic climates, trouble with the electrically-heated suit is entirely the fault of the careless flier. You will get along fine with electrically-heated clothing if you

TAKE CARE OF YOUR CLOTHING
DO PREFLIGHT CHECKS EVERY TIME

Frostbite

Frostbite is just as serious and may be more serious than a wound from flak or a bullet. It can ground you just as surely as a bullet can, and it can keep you in the hospital for months. *Frostbite can be prevented!*

WHO GETS FROSTBITE? Frostbite is almost always due to carelessness, or lack of experience, or both. Five times as many fliers get frostbite on their first missions as those who have had previous missions. THERE IS NO NEED FOR THIS—BECAUSE—a flier going on his first mission will *not* get frostbitten if he knows how to protect himself and if he is not careless. Know how to wear and take care of your clothing, and take the few precautions described here, and you will not get frostbitten.

WHAT YOU SHOULD KNOW ABOUT FROSTBITE. The parts of the flier's body which are most likely to get frostbitten are his HANDS, FEET, and FACE. Frostbite does not hurt much. What you feel when it first comes on is just a little tingling in your fingers or toes or face. You may then feel the affected area get numb and stiff, and it looks pale. That is *all* you may notice in the air, but that may be enough to put you in the hospital for months, or even cripple you!

HOW TO PREVENT FROSTBITE. These are the precautions you must take:

1. Know your clothing—how to wear it, take care of it, and preflight check it.

2. NEVER be careless.

3. Take extra precautions, like wearing the face and neck protector, if you are in a position exposed to wind blast.

4. If you wear electrically-heated flying clothing, take along regular heavy flying clothing, including boots and gloves.

5. Wear dry, woolen socks.

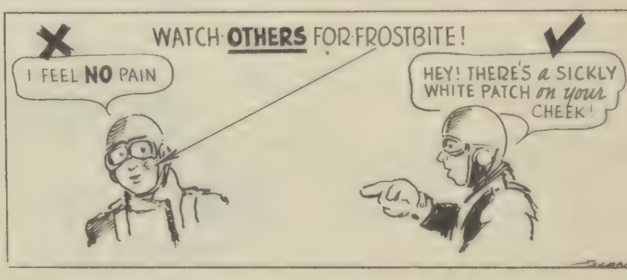
6. Wear glove inserts under your outer gloves.

7. DON'T wear tight clothing; don't wear so many pairs of socks that your boots fit tightly; don't wear more than one pair of glove inserts.

8. DO NOT take a glove off at altitude. Practice, while you are wearing your gloves on the ground, all the maneuvers which you may have to do with your hands during flight. Be able to do all these things at altitude with your gloves on.

NOTE. If you ever have to remove a glove in an emergency at altitude, do not remove the rayon glove insert. The inserts are not adequate, but they are better than nothing. Get the outer glove on again as quickly as possible.

9. Members of an air crew should watch each other as much as possible for the first signs of frostbite. Watch any exposed part of the face. The danger sign is the tell-tale blanching of the skin.



TO LOSE your FINGERS, TOUCH METAL OBJECTS while at FREEZING TEMPERATURES ALOFT

10. Take immediate "first aid" action at the first sign of any tingling or numbness you feel. Remember that frostbite does not hurt much; if you feel tingling or numbness, frostbite may have begun to set in.

ABOVE ALL, DON'T put a bare hand on metal in the cold, as in trying to clear a jammed gun. Be able, through practice, to do this with both gloves on. The skin of a bare hand in contact with cold metal freezes to the metal and results in the worst kind of crippling frostbite.

WHAT TO DO FOR FROSTBITE IN THE AIR. Remember this—if you have no feeling in your fingers, toes, or cheeks, or if a crewmate tells you that an area of your skin looks blanched or pale, YOU HAVE FROSTBITE. EARLY TREATMENT HELPS! DON'T WAIT!!

If hand or finger is frostbitten:

of course, get your gloves on immediately if they aren't already on; then put your hand under an armpit, or between your legs, or inside your clothing.

If toe or foot is frostbitten:

try to improve the circulation by jumping up and down, or stamping your foot.

In any case of frostbite:

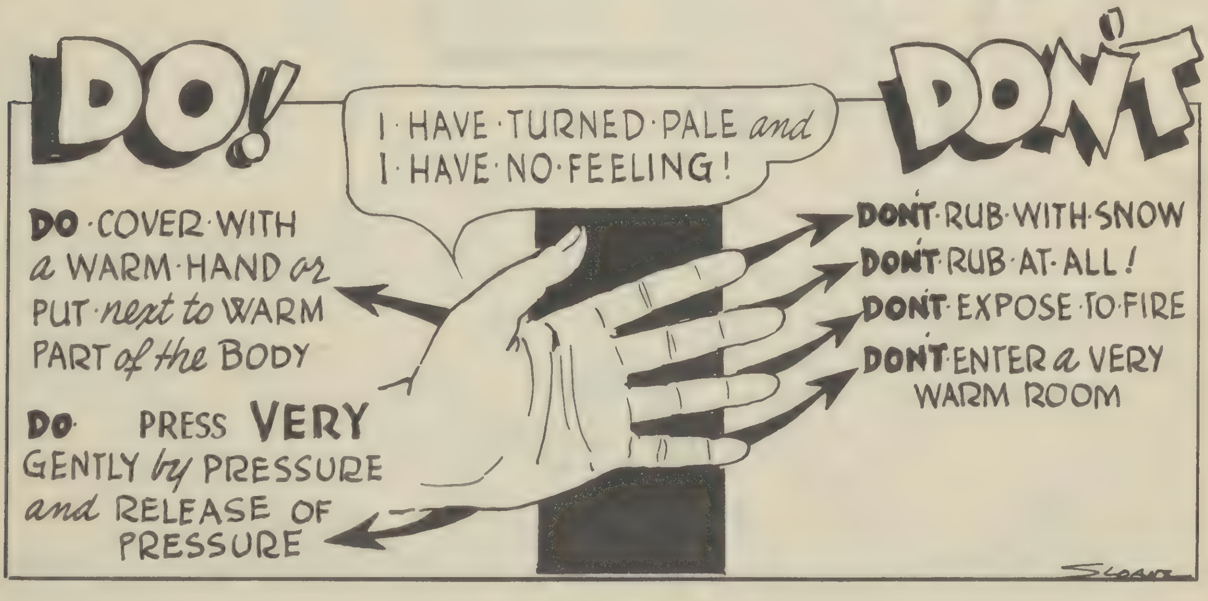
get to the warmest place in the ship that you possibly can;

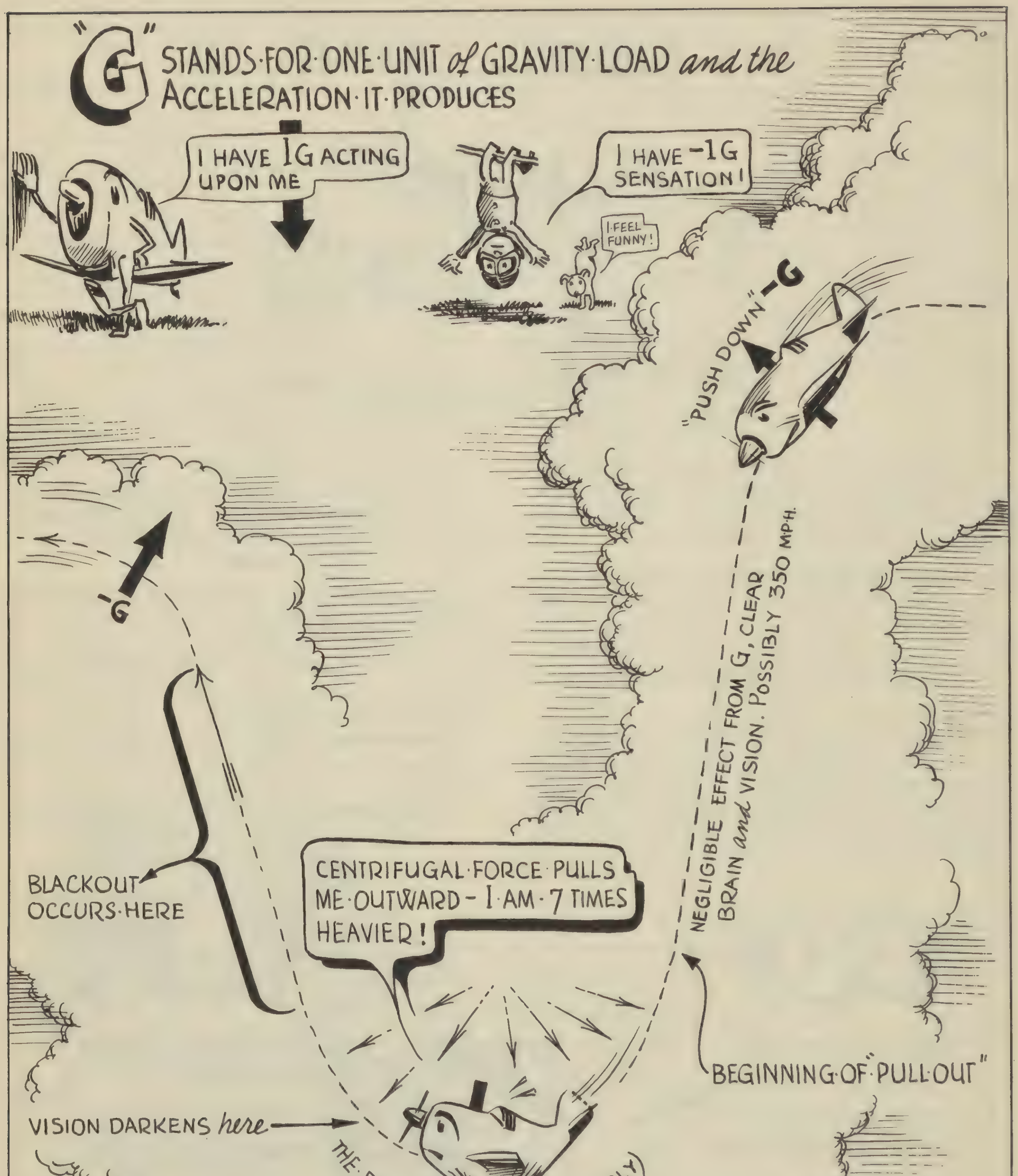
do not rub a frostbitten part;

do not warm a frostbitten part too quickly;

report to your Flight Surgeon immediately after landing.

REMEMBER FROSTBITE CAN CRIPPLE YOU OR IT CAN BE PREVENTED
TAKE YOUR CHOICE




"G" STANDS·FOR·ONE·UNIT of GRAVITY·LOAD and the ACCELERATION·IT·PRODUCES
I HAVE 1G ACTING UPON ME
I HAVE -1G SENSATION!
I·FEEL FUNNY!
"PUSH DOWN" -G
-G
NEGLIGIBLE EFFECT FROM G, CLEAR BRAIN and VISION. POSSIBLY 350 MPH.
BLACKOUT OCCURS·HERE
CENTRIFUGAL·FORCE·PULLS ME·OUTWARD – I·AM·7 TIMES HEAVIER!
BEGINNING·OF·"PULL·OUT"
VISION DARKENS here
THE·PULL·OUT
+7G (POSSIBLY)

SECTION 6 G FORCES-BLACK OUT AND RED OUT

Gravity—friend or foe?

Friend—on the ground, where there is not "too much" of it, and it acts in "one" direction, pulling you down and keeping you "put" on the earth.

Foe—in the air, for you defy gravity when you fly. As a flier, you learn that there can be "too much of a good thing"—in this case of gravity force—and that it can act in some unpleasant directions.

What is G?

The weight of any body at rest, including your own, is determined by the force with which gravity pulls it down. We call this force 1 G. Sitting on the ground, or in your airplane when it is flying straight and level at a constant speed, you have a force of 1 G acting on you. Since this force acts from head to foot, pulling you down into your seat with a force equal to your own weight, we call it *plus* 1 G. A force equal to your own weight which acts on you in the *opposite* direction, from foot to head, lifting you *out* of your seat, is called *minus* 1 G. You can get the sensation of minus 1 G by hanging from a horizontal bar by your feet (head down).

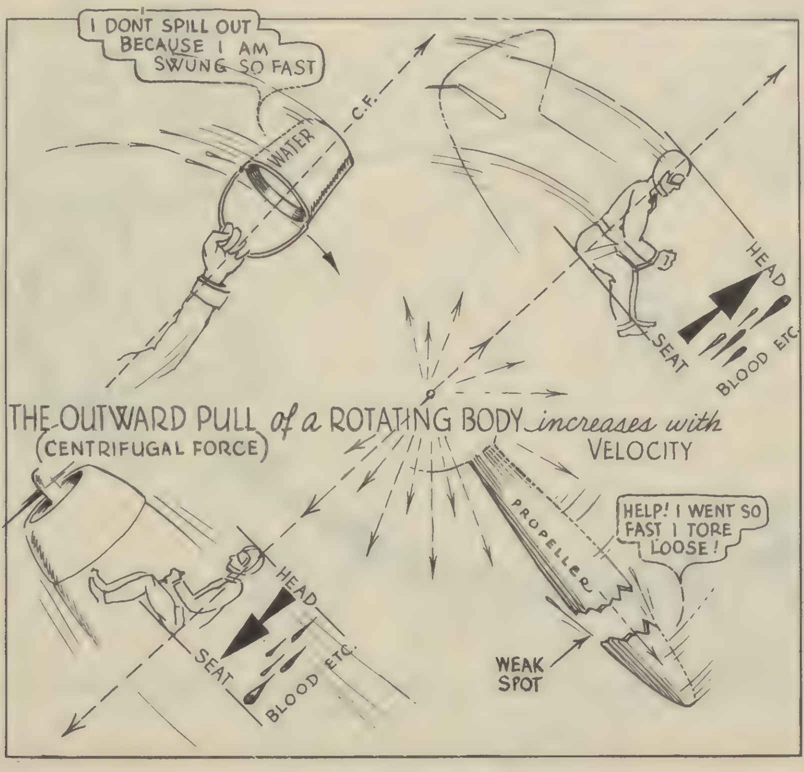
The G force acting on you is increased (+2 G, +3 G, etc.), or decreased (—2 G, —3 G, etc.) when your airplane flies in a curved path!

How G forces increase in flight

In flight, higher G forces act on you as a result of changes in direction, as when you turn, loop, or dive. A flier sitting in a plane that is doing an inside loop is like the water in a bucket you are swinging in a circle from head to foot. Centrifugal Force (CF) tends to push the flier down into his seat, as it tends to push the water down into the bottom of the bucket. When the airplane does an outside loop, CF tends to lift the flier *out* of his seat.

Depending on the direction in which CF acts on the flier, it will give him *plus* G—as in a pull-out; or *minus* G—as in a push-down.

Depending on the force with which CF acts on the flier (how many times greater it is than the force of gravity), it will give him 2 G, or 3 G, or 4 G, and so forth. The CF and therefore the number of G increase as the turn gets "tighter" and the speed of the plane gets greater. Making the turn twice as "tight" only doubles the G—but—making the speed twice as great quadruples the G.



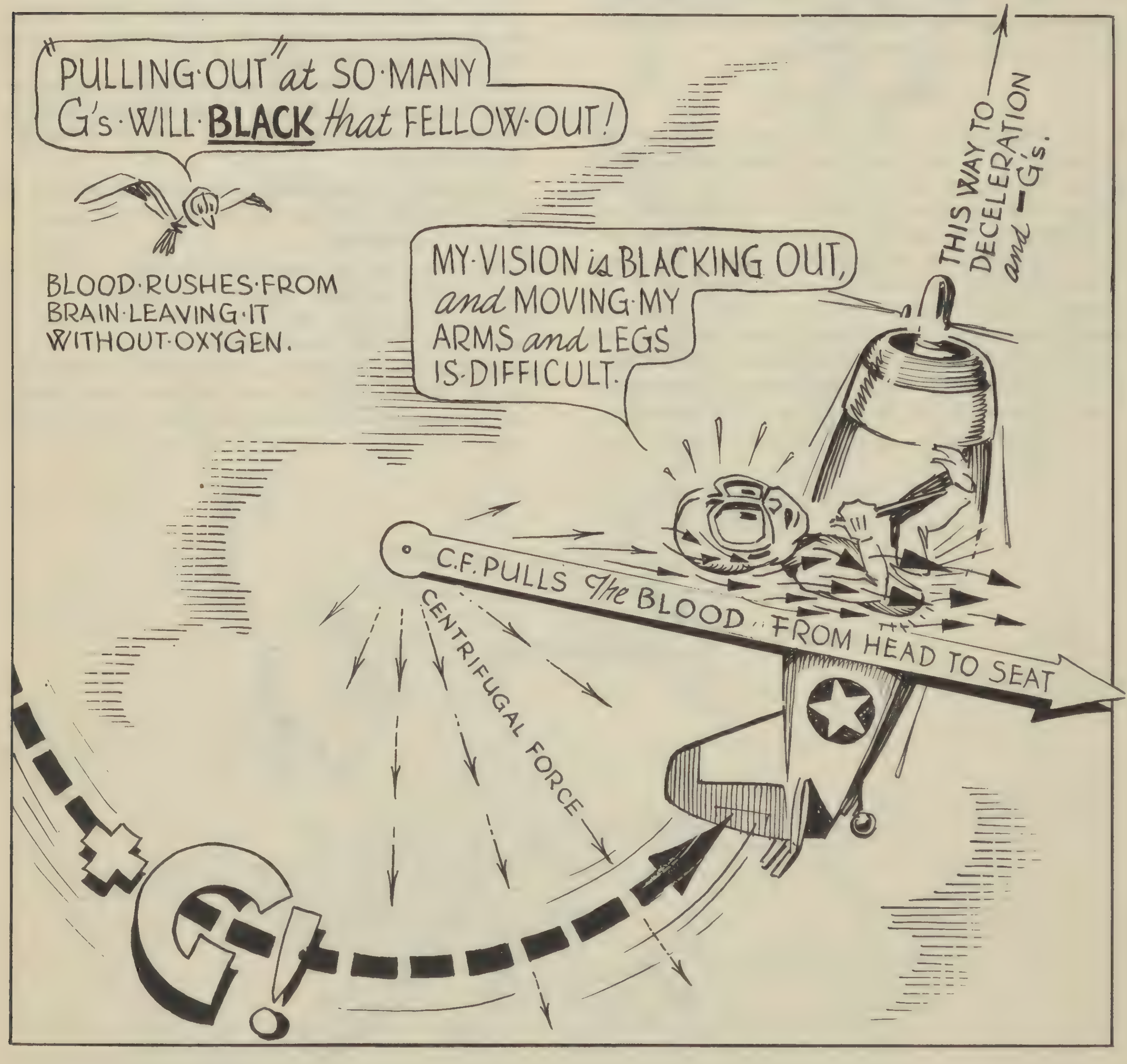
What G forces do to you

How much G force you can stand and what it does to you depends on the *direction* in which the G force acts on you:

In a pull-out G force acts on you from head to foot. The force of *plus G* pulls the blood in your body from your head to your feet. The harder plus G pulls your blood down, the more difficult it is for your heart to pump blood into your head, keep the blood circulation going in your brain and keep you conscious. Normally (+1 G) there is a "column" of blood about 12 inches high between your heart and your brain. At +5 G your heart must pump 5 times harder, which is the same as if that column of blood were 60 inches high!

In a push-down G force acts along your body from foot to head. The force of *minus* G pulls the blood from your seat to your head. You can stand much less minus G than plus G, and the effects of minus G are much more unpleasant.

The amount of G a flier can stand also depends on the individual flier. One man may be able to tolerate more G force than another. The flier should know about how much G force he can stand, and whenever possible he should take this into consideration in flying his plane.



What you feel in a pull-out

At plus 2 G, you feel as though something were pushing you down *hard* into your seat. At plus 3 G to plus 4 G, it becomes very difficult for you to lift your arms or legs. The poor blood supply to your head first causes you to "see gray" (gray-out) at plus 3-1/2 G to plus 5 G. If the G force increases a little, your vision fails and you cannot see at all (black-out), but you remain conscious. If the G force increases still more and lasts long enough, you may lose consciousness. If you are an average flier, you will black out at plus 4 G to plus 6 G continued for 3 to 5 seconds. Higher G will cause unconsciousness.

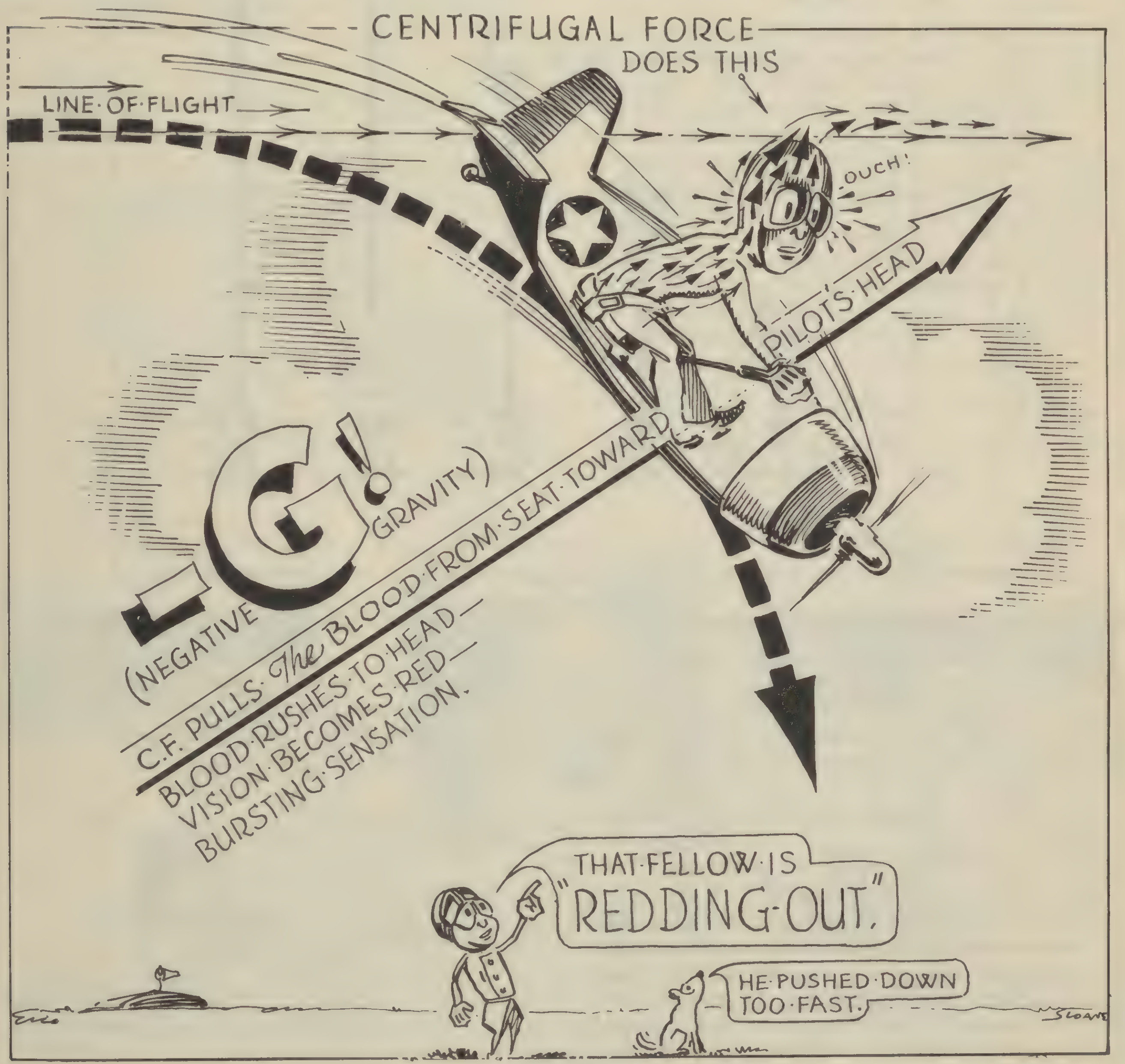
BLACK-OUT IS NOT UNCONSCIOUSNESS. In black-out, you cannot see, but you remain conscious and you know where you are. In unconsciousness, you are really "out," and when you "come to" you are "dreamy" at first: it takes you a little while to discover where you are, and to become mentally alert again.

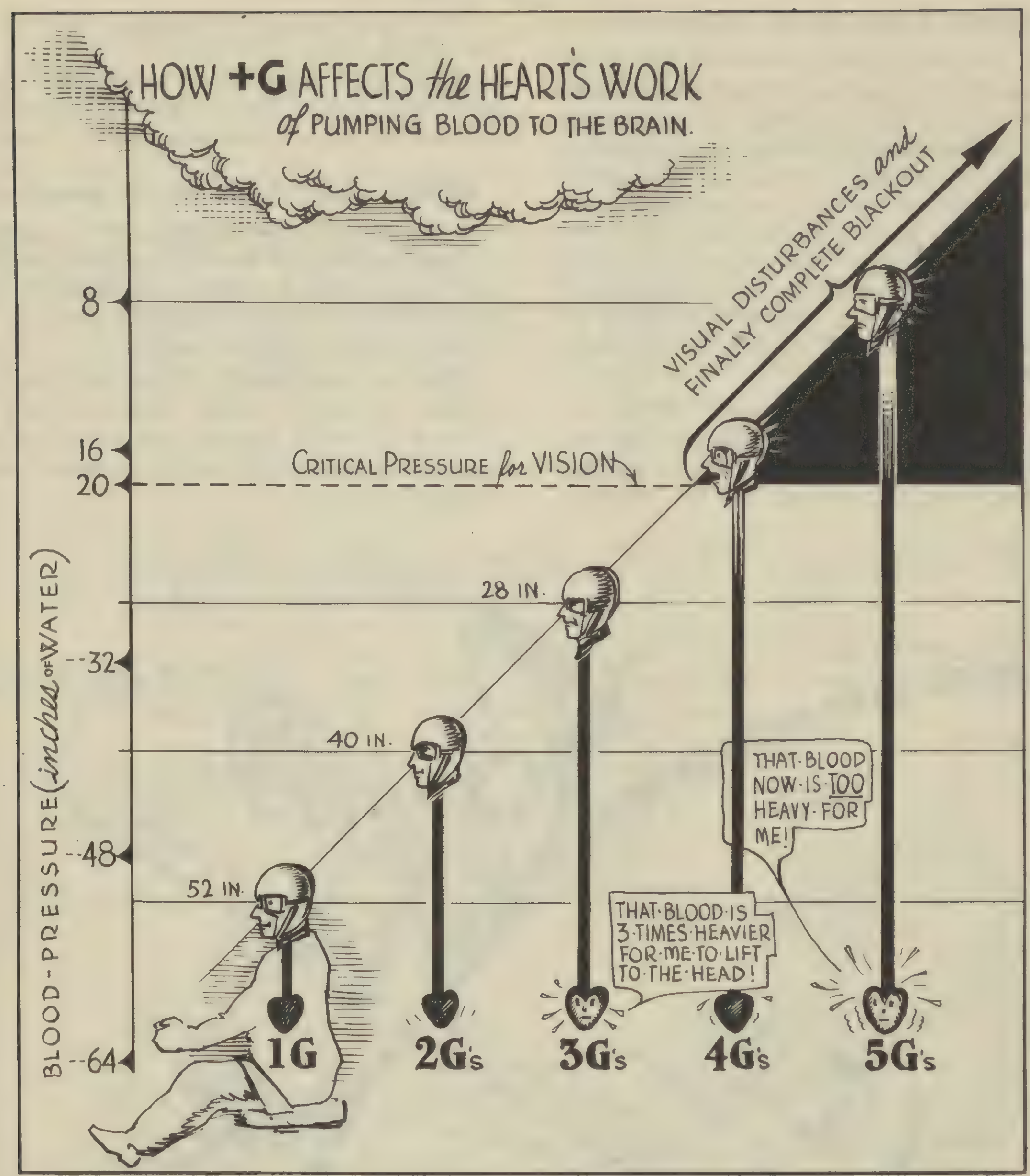
When the G force ceases: *in blackout*—you will recover sight in from 2 to 3 seconds; *in unconsciousness*—you will recover consciousness in from 15 to 45 seconds.

What you feel in a push-down

A push-down is just the opposite of a pull-out. Minus G causes an excess of blood in your eyes and brain. Your eyes bulge and have a "gritty" sensation in them; your head throbs; and very occasionally you "see red"—any of these effects is called "red-out."

After too much minus G you may have a very unpleasant headache for hours. You can't stand more than minus 3 G, and if the force continues too long, your eyes and brain may suffer serious damage. *Outside loops are bad business!*



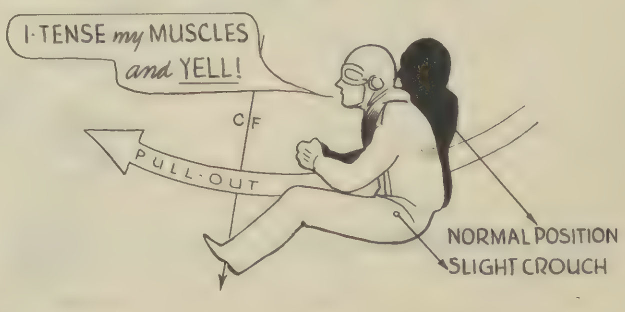


How to protect yourself against G

The easiest way of protecting yourself against these unpleasant effects is, of course, to avoid maneuvers which produce too much G. If you are a dive-bomber pilot or a fighter pilot, this will not always be possible. Under such conditions, there are three things you can do for your protection:

1. Stay away from outside loops! These are the most dangerous.
2. When tactics don't demand a push-down, "peel off" on a dive to get away from minus G.
3. Increase your natural muscular and nervous tension when you pull out of a dive, or when you make a tight spiral. This will help prevent centrifugal force from pulling your blood from head to seat. *To create tension:* Stiffen the muscles of your belly, arms, and legs, and pull your head and neck back and down into your shoulders as you enter the pull-out. At the same time many pilots yell like hell.

Relaxation is ordinarily a boon to good flying, but it is not recommended in pulling out of a dive. It only makes it easier for G force to pull your blood away from your head.



SECTION 7 LIVING THE BALANCED LIFE

Your sense of balance, without which you wouldn't be able to stand on your feet—much less fly—is really made up of three senses of balance. When the three work *together* and send coordinated messages to your brain, you know where you are and exactly what position your body is taking. If they don't work together in the air and your brain gets conflicting messages, you get sick to the stomach (airsickness). If you are deprived of the use of one of them (the eyes) in flight, and you try using the other two without your instruments, you go into spins.

The three senses of balance

1. YOUR EYES tell you where you are in relation to other things around you. They are probably of greatest importance in maintaining balance.

2. YOUR INNER EAR contains something that looks like a pretzel, but which is a very sensitive instrument of balance. The "pretzel" is made up of 3 semicircular canals, each placed in a different plane, and containing a special liquid. Even the slightest movement of your head causes this liquid to move in the opposite direction and vibrate tiny nerve hairs lining the inside of the canal. This vibration sends messages to your brain and tells you where you are. But—the messages can often play dirty tricks on you if they are not coordinated with what you *see* with your eyes. That's the reason you can't fly blind!

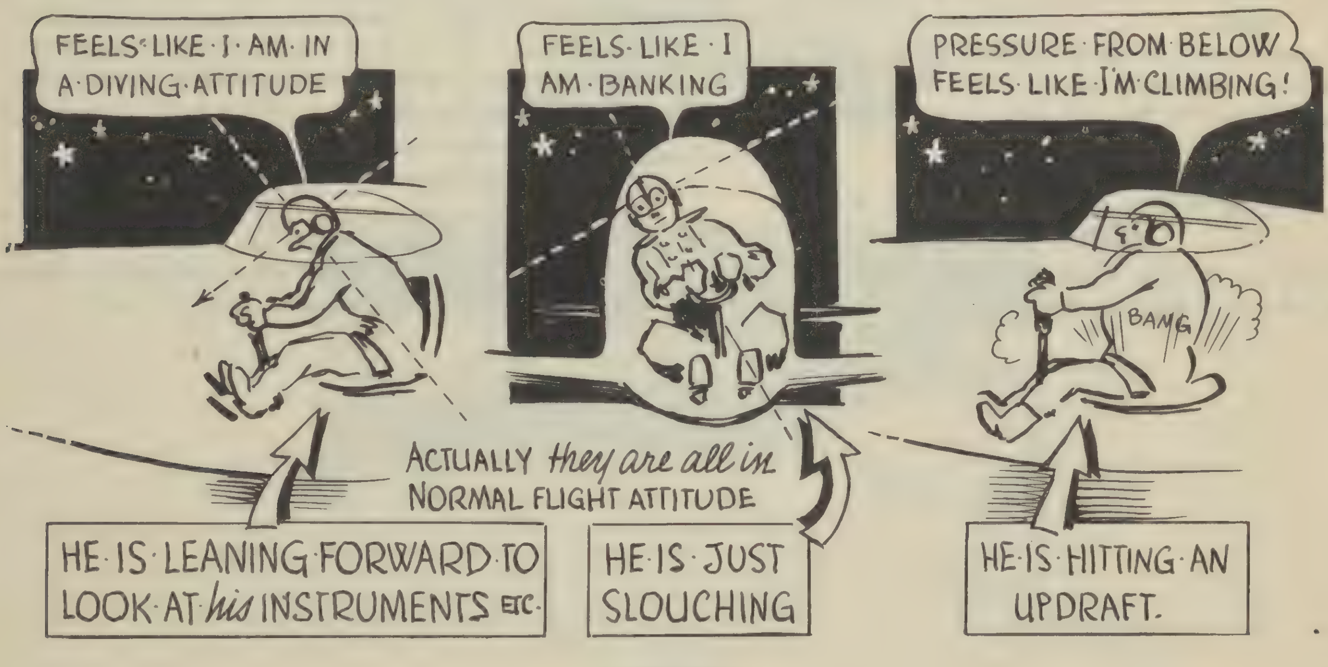
3. YOUR "MUSCLE SENSE" comes from changes in pressure and tension on your tendons, ligaments, muscles, and joints. With it, you feel what position you are in. It enables you to fly by the "seat of your pants." But—muscle sense registers all movements as if they were up or down. Again, you need your eyes to tell you reliably of circular movements.

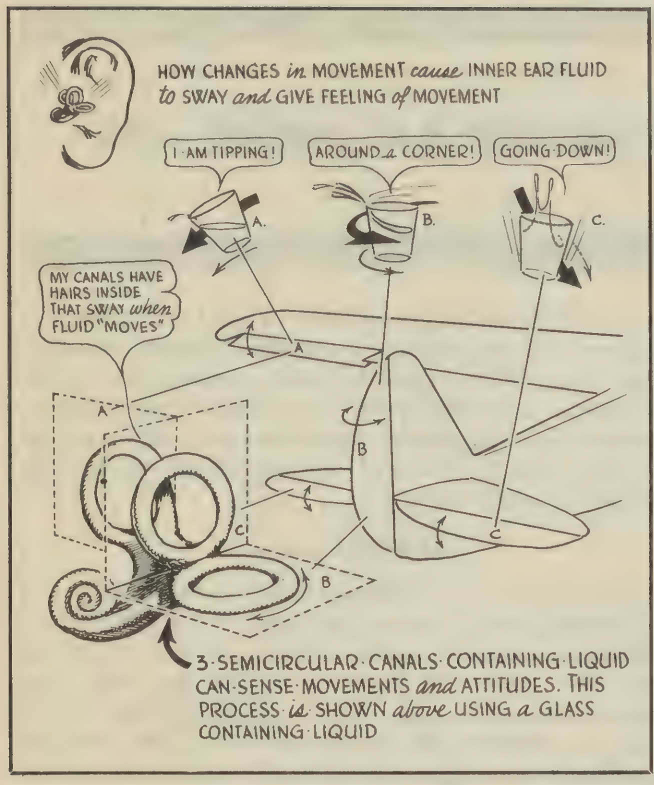
Airsickness

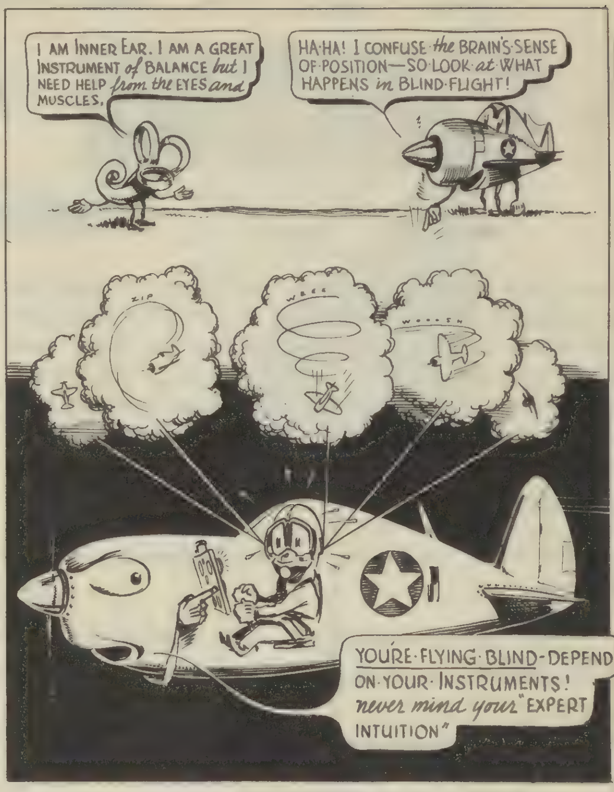
Like seasickness, airsickness is tied up with poorly coordinated messages sent to the brain by the three senses of balance. Flight involves new types of motion for the new flier. Some new fliers may at first get dizzy, nauseated, and vomit—especially in rough weather and if they are placed in the tail of the ship. They soon get used to the new types of motion, however, and are no longer disturbed by them. The new flier who does not easily get used to these motions and gets airsick often needs the special attention of his Flight Surgeon. The Flight Surgeon can usually do a great deal to help him. The same applies to the more experienced flier who has not been airsick since his early training days but suddenly begins to suffer from airsickness again.

What to do about airsickness

Here are some things that may be tried to prevent or decrease airsickness:







1. Take a position as near as possible to the plane's center of gravity, and, if possible, lie down.
2. Keep your eyes on some point outside the plane whenever possible.
3. Wear warm, comfortable clothing.
4. Use oxygen.
5. Use cotton ear-plugs to reduce noise.
6. Use a cushion to absorb vibration.
7. Get all the ventilation possible, to remove unpleasant odors.
8. Avoid large amounts of liquid and greasy foods before flight.
9. Above all, see your Flight Surgeon. Each case of airsickness may be a little different from others. Your flight surgeon is the man who knows what to do and can help you.

Pigeons, instruments, and blind flying

MANY A GOOD MAN HAS DIED trying to prove he was better than the homing pigeon.

The homing pigeon, born to fly, refuses to fly if he runs into a fog and cannot see. He simply sets his wings for a glide to the ground. If a homing pigeon can't fly without visibility, man certainly can't.

YOU CANNOT FLY BLIND WITHOUT INSTRUMENTS. The flier needs his eyes to see the earth, which he uses as a reference point to orient himself in space. When a pilot can't see because of clouds, fog, or darkness, his other two senses of balance are inadequate and play tricks on him. Coming out of a spin, he will have the sensation that he is still in it; he will keep turning in the opposite direction until he goes into a second spin.

YOU CAN'T FLY BLIND—and live long. But you can use your fourth sense of balance.

INSTRUMENT FLYING is man's fourth sense of balance, and allows him to fly safely without his eyes. But the flier must forget all about his sensations and trust the instruments. That is the key to success in instrument flying—pay no attention to what you feel.

SECTION 8 — HOW TO BE A NIGHT OWL

In combat and tactical missions at night LIFE DEPENDS ON WHO SEES WHOM FIRST.

There are times you can look right at the enemy and not see him. In fact, you will see him best at night if you *don't look right at him.*

Here's why: you *see* with the photo-film at the back of your eye. This photo-film has two kinds of sight organs, CONES—for day vision and RODS—for night vision.

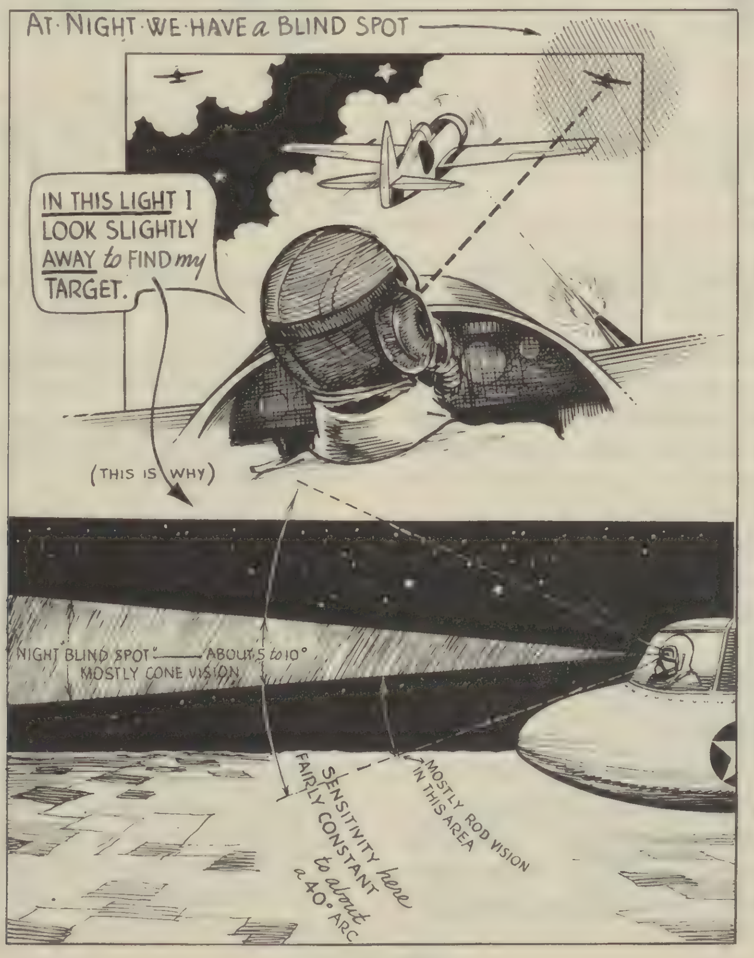
With the Cones:	*With the Rods:*
You have day vision	You have night vision
You see fine detail	You do not see fine detail
You see color	You see only shades of gray
	You do see movement

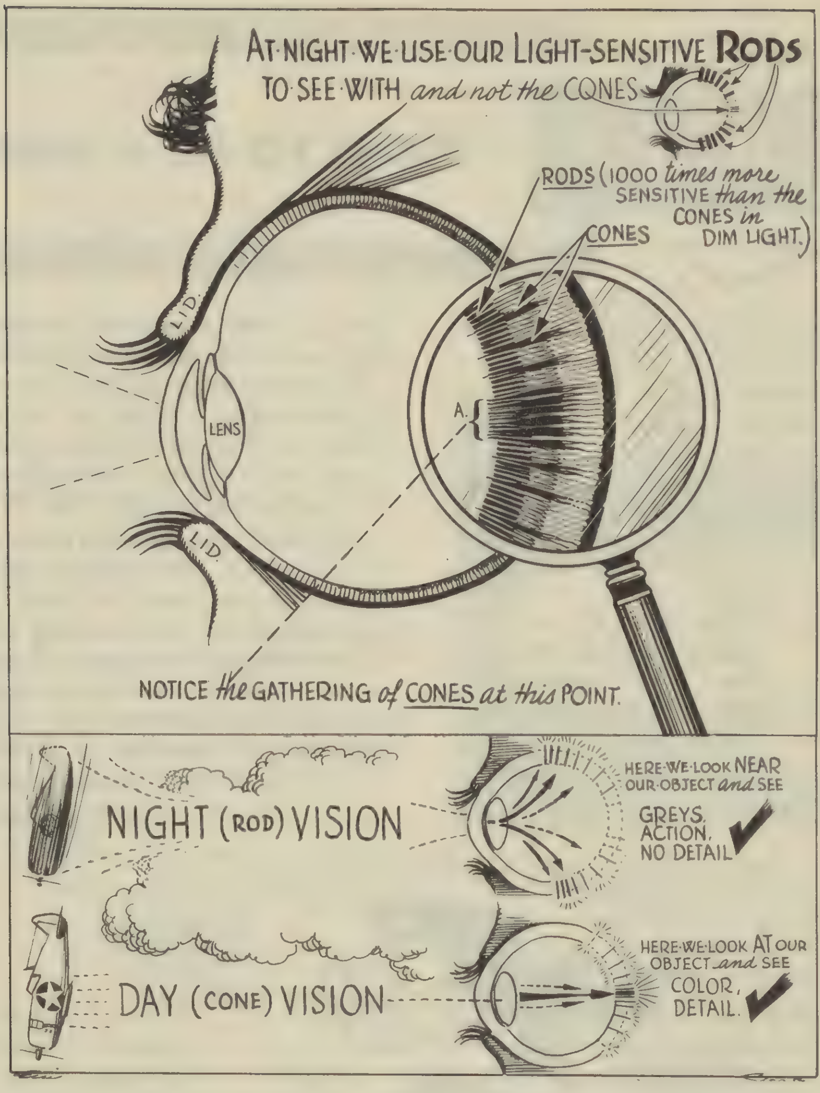
The rods are better than the cones at night, because rods are 1000 times more sensitive than cones in dim light, after you get them used to the dark.

Here's the important fact for you: there are *no* rods in the bull's-eye center of the eye's photo-film, only cones. ALL the rods are away from dead center. That is why YOU HAVE A BLIND SPOT AT NIGHT IN THE BULL'S-EYE CENTER OF YOUR EYE.

The blind spot covers an area of about 5 to 10 degrees in your vision. You must use the remainder of the 40 degrees of your vision in order to see at night. When you look directly at something at night, you are trying to see with your blind spot! You must look to one side of the object in order to see it best. In fact, the best method is to move your eyes slowly from side to side. The thing to remember at night is:

TO SEE THE TARGET MOST CLEARLY,
DO NOT LOOK DIRECTLY AT IT!





How to improve your night vision 10,000 times

Everybody knows that when you go from bright daylight into a dark movie theater you are almost blind at first. Pretty soon you begin to see things vaguely, and after 30 minutes you can see quite well. That is called adaptation to the dark—you have gotten used to the dark and you are "seeing with your rods."

But this is amazing—after 30 minutes in the dark you can see a light 10,000 times dimmer than any you could have seen when you first came in out of the bright daylight.

10,000 times! But it's pretty sensitive. If someone comes along and flashes a bright light in your eyes after they are fully adapted to the dark, you lose that adaptation, and it takes you a while to get it back again.

WHAT THE FLYER LEARNS FROM THIS is to spend 30 minutes in a dark room before a night mission, and after that to avoid looking at bright lights, like the instrument panel, cabin lights, searchlight beams, and so on.

Some interesting things about night vision

Here are some important facts that will come in handy, especially for combat fliers:

1. Each eye adapts separately to the dark. If you have to look at a light, close one eye—it will keep its dark adaptation!
2. There is great variation in how well different individuals can see at night—one man may be able to see at night with only one-tenth of the light needed by another man—and this has nothing to do with how well they can see during the day! But—
3. No matter how good or bad your night vision is, you can double it by practicing off-center glances at things in dim light.
4. Night vision is ruined if you do not get enough vitamin A (foods like eggs, butter, cheese, greens, liver, apricots, and peaches). A certain minimum of vitamin A is necessary for good night vision but too much vitamin A will neither harm nor help.
5. Windshields, especially dirty ones, cut down your vision at night, because they reflect light.

When is red light a "go" signal?

When you want to read while you adapt your eyes to the dark!

If you wear special red goggles, you can sit in a lighted room—and even read—and after 30 minutes you will be "dark-adapted." You leave your red goggles on until you get into the dark, ready to take off.

Never use these red goggles during the day. They are *not* sun glasses.

You can use your red goggles in your airplane. For instance, you can slip them on if you are caught in a searchlight beam, thus protecting your night vision.

Red light can also be used in planes, where it can give you enough light to see by, and yet not spoil your night vision, as ordinary light would.

Seven ways to be an owl

TO *GET* AND *KEEP* GOOD NIGHT VISION:

1. ADAPT. Spend 30 minutes in a darkened room, or wear red goggles for 30 minutes before a night mission.

2. AVOID LIGHTS. Don't stare or look too long at a lighted instrument panel; read the dials fast. Keep interior lights dimmed and shaded. And avoid searchlight beams; if you can't, close one eye or put on red goggles.

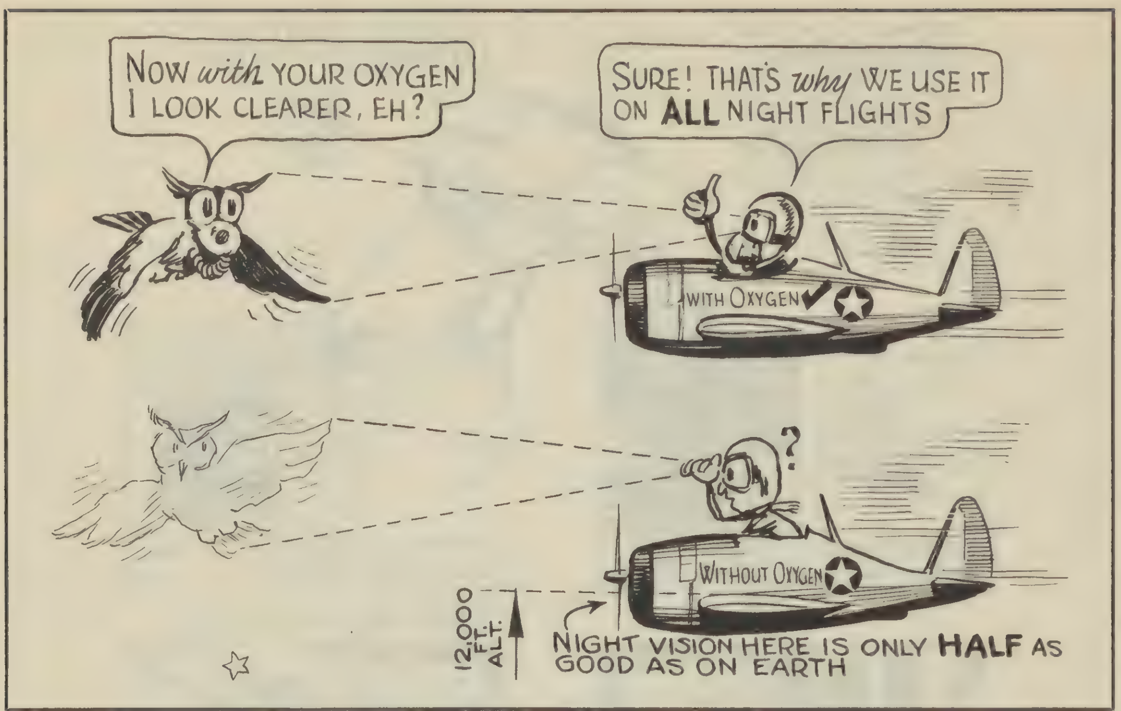
3. LOOK TO ONE SIDE. Shift your gaze from side to side if you want to see the target; *don't* look directly at it.

4. PRACTICE. Practice off-center glances out-of-doors at night. Double your night vision!

5. KEEP WINDSHIELDS CLEAN—scrupulously clean.

6. GET ENOUGH VITAMIN A. Eat the proper foods.

7. USE OXYGEN FROM THE GROUND UP on all combat and tactical missions at night.



Oxygen is the pay-off

At night, high altitude life begins on the ground! Because you use oxygen from the ground up at night.

If you want to get technical, the brain is not the most sensitive part of your body to oxygen lack. The most sensitive are those little rods in the photo-film of your eye with which you see at night. If you breathe air at 8,000 feet your night vision is reduced 25 percent; at 12,000 feet it is reduced 50 percent.

Breathing oxygen restores it to normal!! But it may take quite a while to get it back to normal if you start oxygen after you are in the air. Start your oxygen *on the ground* at night!

25% 50% 100%

Figures, huh? They'll be more than figures if you can't see that * ‡ ! ; / Jap Zero because you haven't put on your oxygen mask. Give yourself a break. At night, put that mask on before you leave the ground!

Stare vision at night

THE C. O. WAS PUZZLED. The wing man was mad enough to eat nails—or the lead pilot, whom he accused of trying a wing-over in night formation! The lead pilot completely denied the story, swearing he had done only a gentle left turn. But the fact was that the wing man had gone into a dive with power on, and had pulled out just in time. *Who was right?*

They were both right, but they didn't know it then, because they didn't know about stare vision at night, the thing that makes a flyer "see things." Stare vision at night (your flight surgeon calls it "autokinetic movement"!), makes it appear that a light is moving when it is really stationary; or that it is moving to the side when it is really going straight ahead.

A person who stares at a fixed light in an otherwise dark room will soon think the light has begun to move. Soon it will seem that the light is swinging in wide arcs. If he stares at the light long enough he may become almost "hypnotized" by it, so that it takes up all his attention and he is almost unconscious of everything except the "moving" light.

A situation very much like this explains the different stories of the lead pilot and wing man; and also has been the cause of unfortunate accidents. A lead pilot may do only a very gentle left turn, but if at the same moment that "moving" light appears to the wing man to be going down and to the right, it may actually look as though the lead plane is taking a violent climbing turn to the left. The wing man may respond to this by trying to regain what he thinks is "straight and level," but what is actually a power dive. If this is started at too low an altitude he may not come out of his "dream state" in time to pull out.

The best way to prevent the dangerous results of stare vision at night is:

DON'T STARE AT NIGHT!

As a matter of fact, you get the best night vision by looking slightly away from an object instead of directly at it, and by shifting your gaze from side to side.

SECTION 9 GETTING DOWN TO EARTH

How to save your neck

"Pilot to crew—pilot to crew—HIT THE SILK—over."

The day you hear that on your headset, five big questions will be facing you.

1. Am I going to be able to get out all right?
2. Is that 'chute going to work right?
3. Am I going to be able to "take" the opening shock of the 'chute?
4. When I land, am I going to pick myself up in good shape, or will I have to wait for someone to put a splint on my leg and get me to a hospital?
5. Gad! What if I land in a tree or in water?

The answers to these questions—pleasant or otherwise—depends on you—on whether you take the advice that follows. Know these things! Do them!

PREFLIGHT CHECK OF PARACHUTE. Be sure that

1. *Parachute has been packed* in the last 60 days (30 days in the tropics); and inspected in the last 10 days.
2. *Rip cord pins* are not rusty or bent, and fit properly in the cones.
3. *Seal* is not broken.
4. *Harness and pack* are in good condition.
5. *Harness fits* so tight that it is comfortable only when you are seated.

If you want that 'chute to open and not injure you, spend 1 minute on the preflight check and the fit.

How to jump

Know how to get to your bail-out exit, if you are in an air crew; or how to leave your ship, if you are a fighter pilot. Air crews should practice this on the ground in emergency drills, wearing full equipment.

If you have never jumped before, there is a natural tendency to want to go out feet first. This is dangerous if the hatch is small, or if anything projects from the plane just behind your exit. Going out head first is much safer.

Head First: Kneel at the aft-end of the hatch, facing forward, and with arms akimbo, right hand grasping the harness near the rip cord—not the rip cord itself. Roll out head first. As soon as you are out, straighten your body and legs.

Feet First: Drop through the hatch in the position of attention—head upright; eyes forward; elbows close to body; right hand grasping harness near the rip cord—not the rip cord itself; body rigid; legs and feet together.

How to pull the rip cord

To lessen the shock put on you by the opening of the 'chute, your body must be in a certain position when you pull the rip cord. It makes no difference whether you are going down head-first, feet-first, or sideways—it is the attitude of your body which counts.

THE RIGHT ATTITUDE.

Body and legs extended
Legs and feet together
Arms close to the body
Head bent forward with chin on chest

NOW—Look down at the rip cord handle,

Grab the ripcord pocket with your left hand,

Grab the ripcord handle with your right hand, and, looking at the handle, YANK IT!

(Don't fling your shoulder out—use your arm from the elbow down.) Your 'chute will open if that preflight check was O. K.

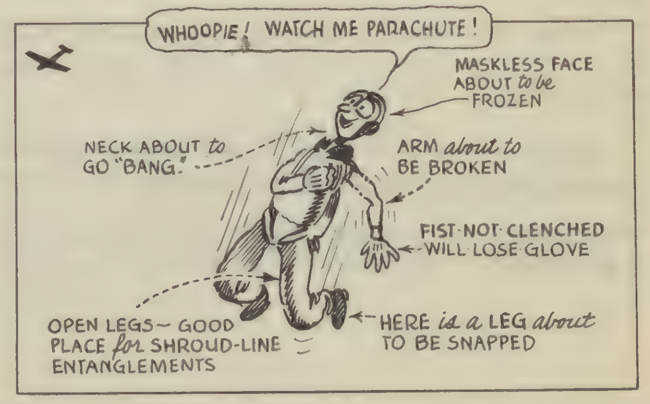
How to manage the open 'chute

After the 'chute has opened, look at the canopy to see if it is fully opened, or if the lines are twisted or tangled. Jerk sharply on a handful of suspension lines to get rid of tangles which prevent portions of the canopy from opening. Twists usually correct themselves; if they don't, a "scissors" kick of your legs will do the trick.

How to prepare for landing

You must be facing downwind at the moment of landing. If necessary, do a body turn in the air.

To make a body turn to the right: grasp the *left* risers with your *right hand behind your head* and the right risers with your left hand in front of your head.



The degree of your turn then depends on how hard you pull on the risers.

To make a body turn to the left: exactly the opposite—*left hand behind your head* grasps the *right* risers, etc.

How to land

Watch the ground from an angle of 45 degrees—don't look straight down.

Grip the risers above your head. Keep your legs and feet together, bending your knees slightly.

Don't keep your body limp or rigid, but "in between." When you hit the ground, you should be moderately relaxed, but alert. When you hit, go into a tumbling roll on your side, with your legs kept together; this helps absorb the landing shock. Unfortunately you don't always hit terra firma—you might come down in a tree or in water. Here again, if you know how, you won't get into trouble.

LANDING IN A TREE is really easier than it would seem and gives *less* shock than landing on the ground. *The proper position:* head forward and arms folded over head to protect your face and eyes. Knees and feet together, but not crossed. If you think you may get help soon, stay where you are instead of trying to free yourself and climb down.

LANDING IN WATER gives the least shock of all, but there are a few special things to know and do here. *Don't* try to judge your distance above the water—it fools everybody. *Don't* get out of your harness before hitting the water. *Don't* get panicky—men don't drown because of the canopy, but because of panic. *Here's what to do:*

Throw away loose gear (oxygen equipment, etc.) as soon as it is safe to do so.

Unfasten the chest strap and slide back on the seat.

Wait until you are in the water to release the leg straps.

In the water, stay away from canopy shrouds by remaining upstream from them.

Use your emergency flotation equipment, but never inflate your Mae West until after you release your chest strap.

Bailing out is like all other emergencies—the more you know about it ahead of time, the less danger there will be.

Bailing out from high altitude

(When Not to Pull a Ripcord)

NO FLIER IN HIS RIGHT MIND will bail out from high altitude if it is possible to ride the ship down to a lower altitude. But fire, a crumpled wing, or threatening structural collapse may make it necessary for you to get out immediately. Your survival in such an event will depend mostly on *two* things.

1. Your "patience"—don't pull the ripcord too soon.
2. Your oxygen—have your bail-out bottle with you and know how to use it.

Any emergency parachute jump has its dangers. A jump from altitudes above 25,000 feet presents additional perils. These are:

1. *The terrific shock* on you and the parachute shrouds if you pull the ripcord too soon. At higher altitudes the opening of the chute puts a much greater shock on you. This may injure you.
2. *Passing out* from oxygen lack in a slow open parachute descent.
3. *Freezing* while floating down through the subzero temperatures of high altitudes.
4. *Strafing* by enemy planes.

If you ever have to get out of your ship at altitude, you can minimize these dangers by using the free fall.

WHY DON'T YOU DROP DOWN SOMETIME? THE FREE FALL is the safest way to bail out from high altitude. It takes:

25 minutes for an open parachute descent from 40,000 feet

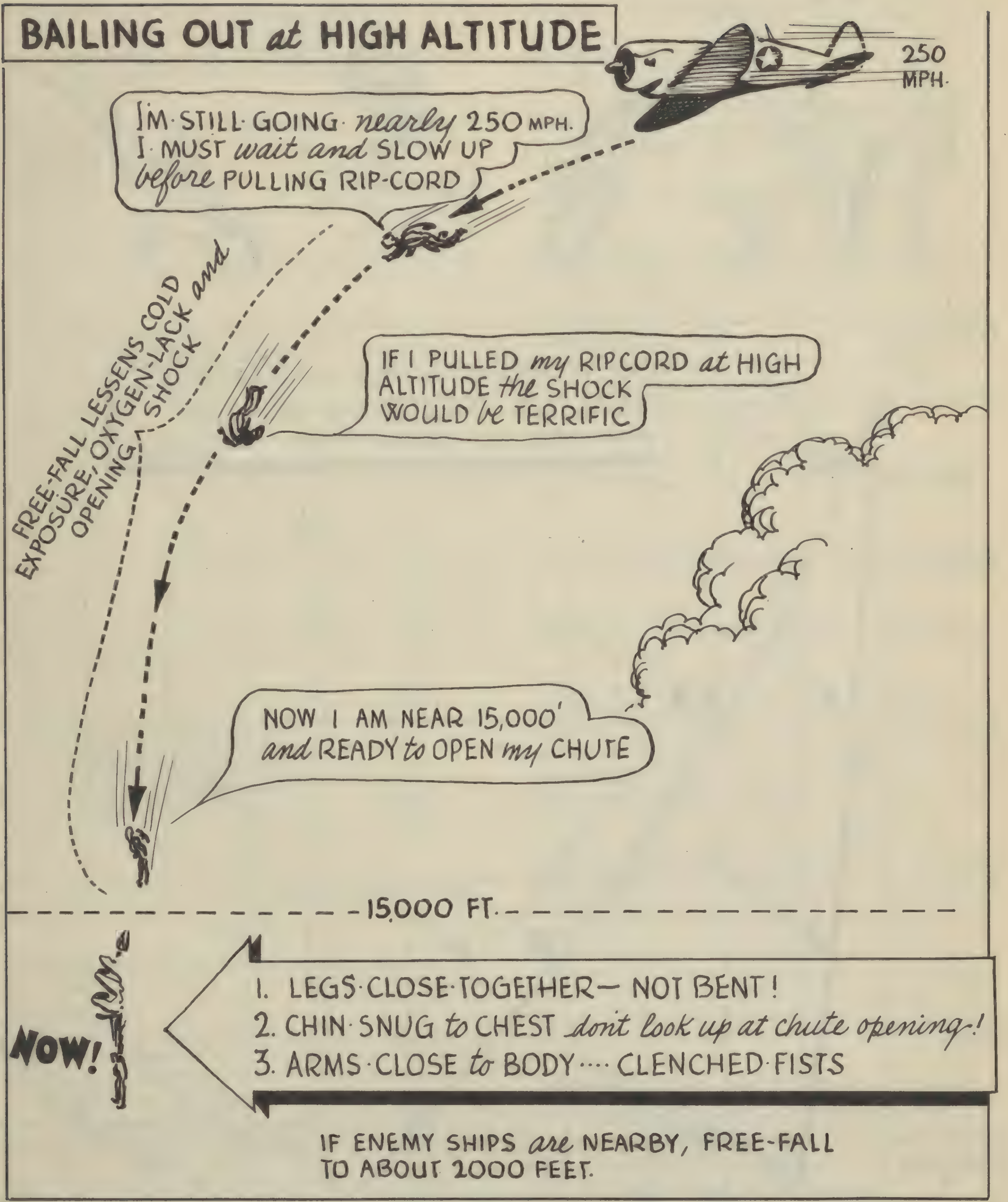
2-1/2 minutes for a free fall from 40,000 feet

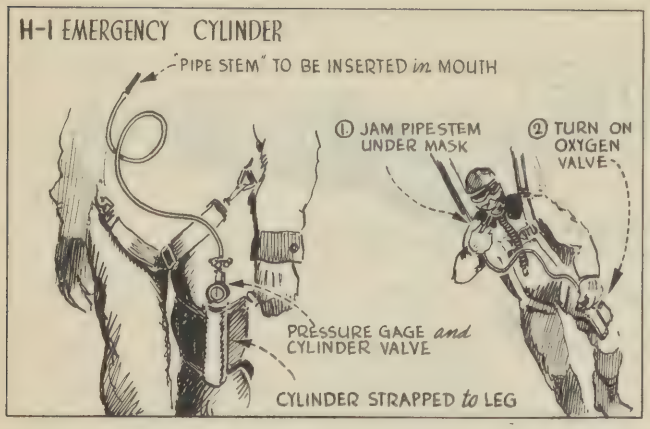
The longer you delay pulling the ripcord, the more you reduce the dangers of a high altitude bail-out. The only disadvantage of a free-fall is the effect on the ears, especially below 15,000 feet, where the changes in atmospheric pressure are greater. The chances of preventing a rupture of the ear-drum are good, though, if you try to clear your ears rapidly. But ruptured ear-drums are mild compared to severe frostbite, enemy bullets, oxygen lack, and the serious injuries from the shock of opening a 'chute at very high altitude.

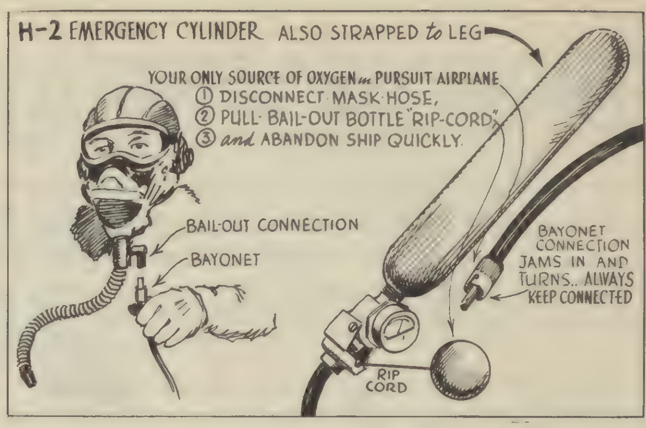
If there is danger of being strafed by enemy gunfire it is best not to pull the ripcord until you are only a few thousand feet above the ground.

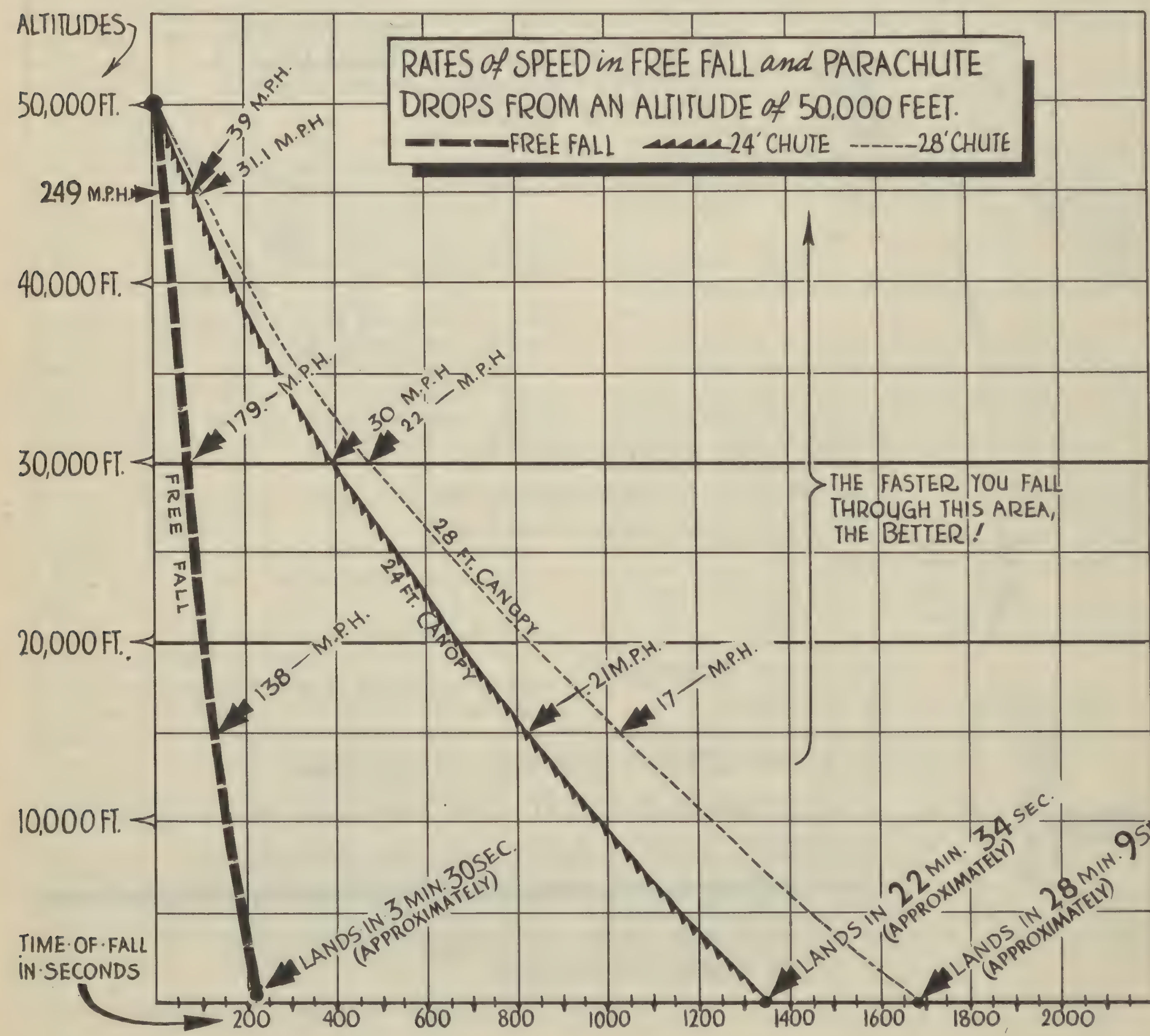
THE SAFEST WAY TO BAIL OUT FROM HIGH ALTITUDE IS TO FREE FALL! NEVER PULL THE RIPCORD AT ALTITUDE! *WAIT!!!*

TO GET DOWN ALIVE the first thing is to stay conscious while you are getting to your bail-out hatch. You can't stroll to your bail-out exit without oxygen. With the excitement and work in getting there, plus no oxygen, you will pass out in less than a minute. You must start to use your bail-out bottle at the same time you pull your mask-hose out of the quick disconnect.


BAILING OUT at HIGH ALTITUDE
250 MPH.
I'M STILL GOING nearly 250 MPH. I MUST wait and SLOW UP before PULLING RIP-CORD
FREE-FALL LESSENS COLD EXPOSURE, OXYGEN-LACK and OPENING SHOCK
IF I PULLED my RIPCORD at HIGH ALTITUDE the SHOCK WOULD be TERRIFIC
NOW I AM NEAR 15,000′ and READY to OPEN my CHUTE
15,000 FT.
NOW!
1. LEGS CLOSE TOGETHER— NOT BENT!
2. CHIN SNUG to CHEST don't look up at chute opening!
3. ARMS CLOSE to BODY .... CLENCHED FISTS
IF ENEMY SHIPS are NEARBY, FREE-FALL TO ABOUT 2000 FEET.


H-1 EMERGENCY CYLINDER
"PIPE STEM" TO BE INSERTED in MOUTH
① JAM PIPESTEM UNDER MASK
② TURN ON OXYGEN VALVE
PRESSURE GAGE and CYLINDER VALVE
CYLINDER STRAPPED to LEG


H-2 EMERGENCY CYLINDER ALSO STRAPPED to LEG
YOUR ONLY SOURCE OF OXYGEN in PURSUIT AIRPLANE
① DISCONNECT MASK HOSE,
② PULL BAIL-OUT BOTTLE "RIP-CORD"
③ and ABANDON SHIP QUICKLY.
BAIL-OUT CONNECTION
BAYONET
BAYONET CONNECTION JAMS IN AND TURNS.. ALWAYS KEEP CONNECTED
RIP CORD


RATES of SPEED in FREE FALL and PARACHUTE DROPS FROM AN ALTITUDE of 50,000 FEET.
FREE FALL
24' CHUTE
28' CHUTE
ALTITUDES
50,000 FT.
40,000 FT.
30,000 FT.
20,000 FT.
10,000 FT.
249 M.P.H.
39 M.P.H.
31.1 M.P.H
179.— M.P.H.
30 M.P.H
22 — M.P.H
138 — M.P.H.
21M.P.H.
17 — M.P.H.
FREE FALL
24 FT. CANOPY
28 FT. CANOPY
THE FASTER YOU FALL THROUGH THIS AREA, THE BETTER!
LANDS IN 3 MIN. 30 SEC. (APPROXIMATELY)
LANDS IN 22 MIN. 34 SEC. (APPROXIMATELY)
LANDS IN 28 MIN. 9 SEC. (APPROXIMATELY)
TIME OF FALL IN SECONDS
200
400
600
800
1000
1200
1400
1600
1800
2000

How to use the bail-out bottle

Two types, both high-pressure (1800-2000 psi), small, slender, green cylinders which fit into the pocket of your flying suit, and are strapped to your thigh. Tie lower straps directly around thigh: put upper straps through parachute harness which runs under leg. The straps come directly off the sheath in which the bail-out bottle rests. If there is no pocket in the flying suit, the sheath should be sewed to the suit.

TYPE H-1. The older type, with a hose leading to a pipestem mouth piece. *Don't remove your mask!* You will freeze your face if you do. Shove the pipestem under the chin of the mask and into your mouth. Then turn open the flow valve at the top of the cylinder. The continuous flow of oxygen will last about 8 or 10 minutes.

TYPE H-2. The newer type, with a hose leading to a bayonet-type of connection which hooks into a protruding inlet just below the junction of your mask and the mask hose. You start the 10 minute flow of oxygen just before you jump by pulling the ball handle of a ripcord which comes out of the top of the cylinder. The oxygen goes right into your mask.

THERE IS ONE OTHER METHOD of *trying* to stay conscious on the way down. It is not as good as the bail-out bottle: Use your walk-around bottle to get to your bail-out hatch; take three or four deep breaths of oxygen; hold your breath; toss the walk-around aside; jump; *free* fall and continue to hold your breath for 30-45 seconds. In that time you will have fallen about 10,000 feet, and it will be less dangerous to breathe air. But continue to free fall—especially if there are enemy planes around.

Do *not* use your walk-around bottle during descent.

Make no mistake about it, it's hardly possible to hold on to that awkward cylinder during a free fall—you'll never hold onto it during the 'chute's opening shock.

REMEMBER: THE SAFEST WAY TO BAIL OUT FROM HIGH ALTITUDE IS TO USE THE FREE FALL AND THE BAIL-OUT BOTTLE.

G force, crash landings, and ditching

Changes in direction cause G forces to act along the flier's body, from head to foot or vice versa, as in loops, turns, and dives.

Changes in speed also cause G forces to act on you, as when your plane comes to a sudden stop in a crash landing; or when the opening of your parachute causes you to slow down very suddenly.

In a crash landing the G force acts across your body. When G acts in this direction, from back to front or vice versa, it is not unpleasant in itself, and you can "take" much more of it than when it acts along your body. Yet G force is related to the injuries fliers can suffer in crash landings!

The trouble in crash landings arises from the fact that, even though the G force is not harmful in itself, it tends to push you forward very suddenly. The G force is not unpleasant, but the sudden contact your head may make with whatever is in the way is very unpleasant—to say the least.

YOU CAN DO A GREAT DEAL TO PROTECT YOURSELF FROM CRASH INJURIES. YOU CAN SAVE YOUR LIFE—IF YOU TAKE THE PROPER PRECAUTIONS.

What to do in a crash landing—pilot

If you are a pilot, use your safety belt and your shoulder harness. The injury resulting from the jamming of the head against the gun-sight, cowling, or instrument panel (the usual thing without a safety belt or harness) is often fatal and always very severe. If you use the safety belt and harness, you may get a good "jolt," but you will save yourself injury.

USE YOUR BELT AND HARNESS.

1. Make sure the safety belt is tight.
2. Pull belt over, not through, the parachute harness.
3. Don't wear a twisted safety belt—it cuts. Straighten it!
4. Be sure the shoulder harness is locked.
5. Be sure the harness straps are over the cross-bar at the top of your seat.

What to do in a crash landing—air crew

If you are a member of an air crew, know ahead of time the exact place to which you are supposed to proceed when the pilot gives the signal to prepare for a crash landing, or for ditching. Go there just as soon as you can after you have attended to your ditching duties; these will depend on your position in the crew. Each man should know his special duties, do them, and then get into the proper position in his assigned place.

Ditching duties and the position to take for crash landing will depend on the ship in which you are flying. What you learn in this book is a general guide. Each air crew will have its own procedure worked out in advance, depending on the particular ship. The important thing is to have the procedure worked out and thoroughly practiced in advance. This will be done under the supervision of the Personal Equipment Officer and the pilot, and practice drills will be held.

Your position in a crash landing

In a crash landing position is everything in life—and *for* life. The important thing is to be properly braced to "take" the force of the crash with the least shock. Here is *the best position* to take:

Sit on the floor with your back and shoulders pressed flat against a forward bulkhead, so that you are facing

the rear of the plane. The forward bulkhead in the radio compartment is generally chosen, but any solid support, like a spar or an armored door, is good.

Keep the back of your head braced against the bulkhead—you will get a "bump" when the plane stops, but not nearly as hard as you would if your head travelled through space, gaining force from velocity, and then struck the bulkhead! If there is nothing against which you can brace your head, bend it forward and clasp your hands behind it, with your elbows brought forward. Pull hard to give it support.

Brace your feet against something solid on the floor in front of you, if possible, with your knees bent slightly and your muscles tensed.

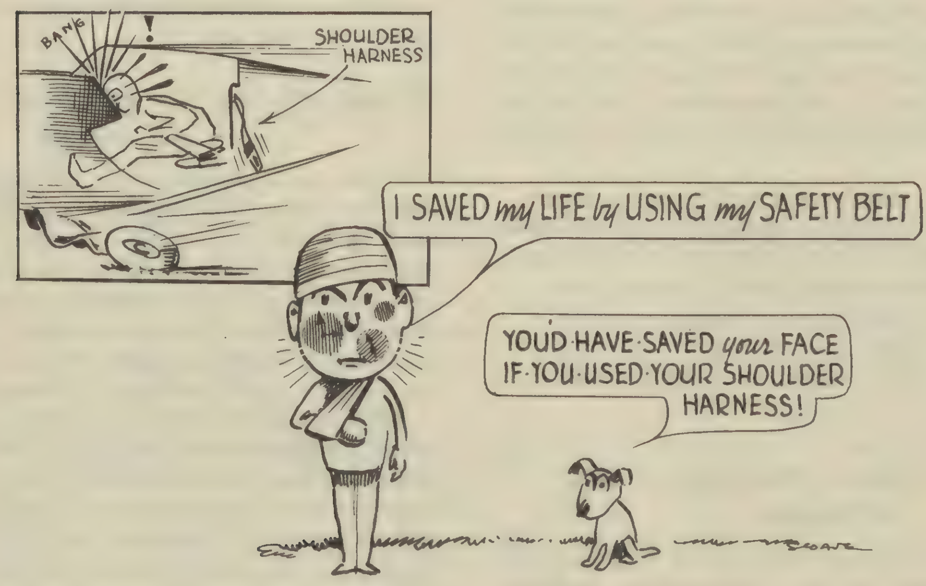
DO NOT MOVE UNTIL THE SHIP HAS COME TO A COMPLETE STOP! In some ships, as many of the crew as possible use the radio compartment for the crash landing. They form two rows, one with backs against the forward bulkhead, as described, and knees bent; the other crew members form a front row, sitting with their backs braced against the knees of those in the back row and using their own clasped hands to brace their heads.

An alternative position is to lie on your back, with your head towards the rear of the plane and your feet braced against something solid. Your knees should be bent slightly and your muscles tensed.

HINT: Seat cushions or parachute packs can be used to help absorb the shock of crash landing.

KNOW YOUR PLACE AND POSITION FOR CRASH LANDING *BEFORE* IT HAPPENS. PRACTICE IN EMERGENCY DRILLS!

Use of the belt and harness, and of the proper position, has saved many lives in crash landings. Failure to use these precautions has cost the lives of careless fliers who should have known better.



SECTION 10

CUTS, CONCUSSIONS, AND COMPLAINTS

THE GOOD FLIER treats himself as another part of his airplane—a very important part, because he knows that he can be the weakest part of that airplane if he doesn't take care of himself. He knows that no instrument of combat or of flying—no matter how fine it is—can function properly or effectively if the man using it is not in good shape.

TO BE A GOOD FLIER you must keep yourself in good condition. No athlete ever had to train himself for a more important job than you have. You don't have to treat yourself like china dish-ware. In fact, relaxation at the proper time is an important part of keeping in good physical and mental condition. All you have to do is to use your common-sense and obey the "ten commandments" of combat-flying health.

Ten commandments for combat-flying health

1. Get enough sleep.
2. Eat sensibly—don't "bolt" your food or miss a meal; avoid foods which you know to disagree with you.
3. Keep physically and mentally fit—get regular exercise and relaxation whenever possible; that does not mean that you should go out on a binge for relaxation if you may have to fly the next day.
4. Don't fly if you are not well—if you have a "cold," the "g.i.'s," etc.
5. If you are not "up to par," physically or mentally, see your Flight Surgeon. Don't hide anything from him.
6. Don't doctor yourself—don't take medicines of *any* kind without the advice of your Flight Surgeon.
7. Know your oxygen equipment—do preflight checks—use oxygen according to Army Air Forces rules.
8. Prevent frost-bite—by knowing how to protect yourself against sub-zero temperatures at altitude, and how to use and take care of your electrically-heated and heavy flying clothing.
9. Keep completely covered in combat at all times—wear helmet, goggles, oxygen mask, gloves, and flak-suit for your own protection.
10. Know how to give first aid.

Remember that saying? About a chain being as strong as its weakest link? A combat crew or squadron is as good as the men who make it up. That's where you come in. It is up to you to keep *your* link in the chain of your air crew or squadron strong. TAKE CARE OF YOURSELF.

Got the jitters?

The first—and the most important—thing to know about fear of combat flying is that it's normal. Everyone feels some sort of anxiety on a combat mission. Combat veterans admit being scared. A recent survey among aircrew members returning from action revealed that all of them were afraid on some missions. They said their biggest fears were of the unknown, of being killed, of personal failure, and of being crippled.

FEAR IS NOT COWARDICE. It is nothing to be ashamed of. Fear is your body's normal way of marshalling all its energy to meet some danger.

You can think faster—and act faster—when your nervous system receives a "red alert." In other words, fear can be useful provided you understand it. Most veterans recognize that fear made them work or fight harder and that action relieved the fear. Few said that it made them lose their heads.

It is true that the speed-up in your body processes produced by fear affects you in many unpleasant ways: a pounding heart, a rapid pulse, muscular tenseness, dryness of throat and mouth, frequent urination, sweating, and a sinking feeling in your belly. These are alarming if you don't understand them.

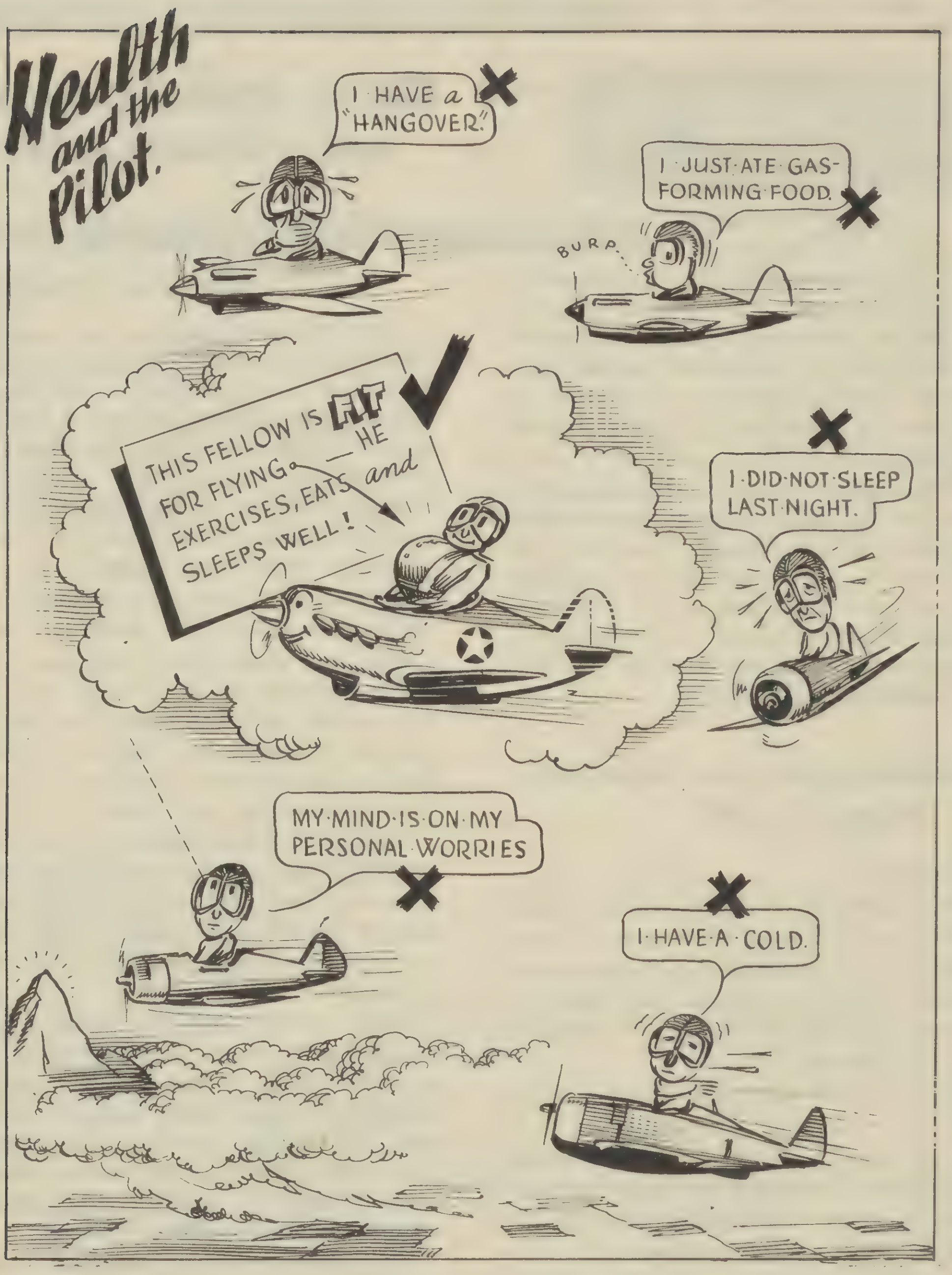
WHAT FEAR DOES TO YOU. Fear creates nervous energy which animal instinct tells you to release by fleeing or fighting. When you can't get sufficient release either way—which often happens—this pent-up energy may have delayed, and disturbing, effects: tiredness or weakness, loss of appetite, nausea, startle reactions, frequent urinations, insomnia, irritability, moroseness, or obsession with thought of combat.

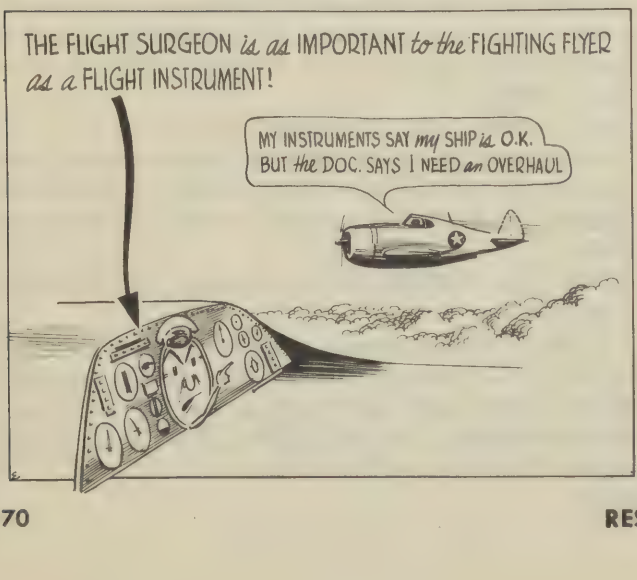
You should learn to recognize these conditions as products of fear—and not of physical or mental ill health. *Most men who succeed in combat have some of these troubles* but very few of them break down because of them.

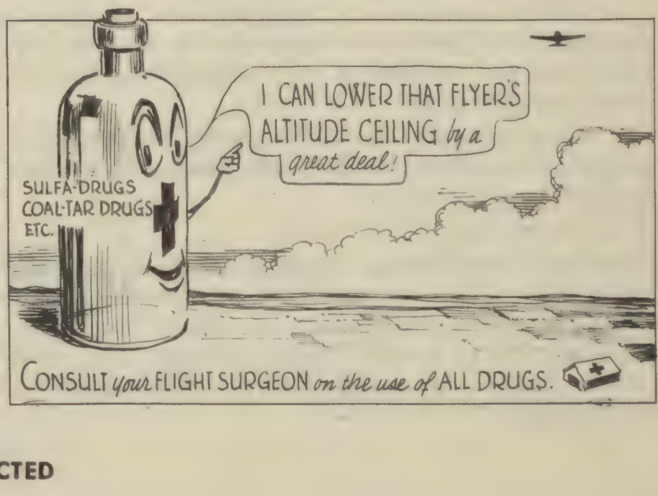
THE THING TO DO when your fears cause you trouble is to talk it over with your Flight Surgeon, who understands both the prevention and cure of operational fatigue. He won't baby you, but he won't let you down, either.

HERE ARE A FEW TIPS to remember in conquering your fears:

1. Don't make a mystery or skeleton in the cupboard of fear. It is common to all men in dangerous situations. It is a normal and useful way of reacting to danger. Simply bringing it out and talking about it takes away a great deal of its unpleasantness.


Health and the Pilot.
I HAVE a "HANGOVER."
I JUST ATE GAS-FORMING FOOD.
BURP
THIS FELLOW IS FIT FOR FLYING — HE EXERCISES, EATS and SLEEPS WELL!
I DID NOT SLEEP LAST NIGHT.
MY MIND IS ON MY PERSONAL WORRIES
I HAVE A COLD.


THE FLIGHT SURGEON *is as* IMPORTANT *to the* FIGHTING FLYER *as a* FLIGHT INSTRUMENT!
MY INSTRUMENTS SAY *my* SHIP *is* O.K. BUT *the* DOC. SAYS I NEED *an* OVERHAUL


I CAN LOWER THAT FLYER'S ALTITUDE CEILING *by a great deal!*
SULFA DRUGS
COAL-TAR DRUGS
ETC.
CONSULT *your* FLIGHT SURGEON *on the use of* ALL DRUGS.

2. If you are well trained in your job, and you know you are, you can use the energy created by fear to increase your efficiency during combat crises. If you think you are not well trained, your fears should warn you to study up on things you're not certain about. Knowledge breeds confidence.

3. If you can't get rid of your feelings of fear in combat, release your pent-up energy in vigorous physical exercise back at the base. Any type of competitive exercise which uses all your muscles is good medicine.

4. Improve your teamwork. A good team is stronger than any individual in it, and teamwork lends strength to its members. The tension is not so bad when you know that every man is doing his job. How can you be sure? There's just one way. If one man in a team keeps trying to do his best, the others will try to keep up with him. That's leadership! That's morale!

The flight surgeon and you

The Flight Surgeon is to the flier what the ground crew is to the airplane. He not only knows what makes you "tick," but he is also *vitally* interested in keeping you "ticking" happily and efficiently.

You wouldn't feel very happy about flying in a ship that hadn't been checked by a good mechanic to whom the slightest sound in an engine or even a quick look at a spark-plug tells a whole story.

Your Flight Surgeon knows about the human body and mind as the engineer and mechanic know about the airplane and engine. That's why he checks *you.*

You will certainly agree with this: any flier who fails to report any kind of poor performance of the airplane to the engineer or ground crew is STUPID. He is endangering his own life and the lives of the rest of the air crew. The results can be disastrous.

This is just as true: any flier who fails to report any kind of physical or mental trouble he is having to his Flight Surgeon is stupid. He is similarly endangering his own life and the lives of his fellow airmen, and the results can be just as disastrous.

There is no doubt about this, either: it would be extremely dangerous to send up an airplane that is known to be in poor shape for flying. Of course, the Flight Surgeon might not know the ship is in poor condition for flying—no matter how good a doctor he is—but that's not his field—it's the crew chief's or mechanic's.

It is just as dangerous to send up a flier who is known to be in poor shape for flying. Of course, *you* might not know that you are in poor condition for flying—no matter how good a pilot, navigator, bombardier, radioman, engineer, or gunner you are—but that's not your field—it's the Flight Surgeon's. What you must do is to report your troubles to him. He knows what to do.

Your Flight Surgeon wants to keep you flying. That is his greatest desire. He would be derelict in his duty, though, if he did not ground you when he knew your condition might endanger your own life and the lives of your fellow airmen; or when he knew that a few days of being grounded now might save you many weeks later on.

Trust your Flight Surgeon. Don't keep anything from him—physical or mental. He's your friend as well as your doctor. Whether you've got the "g.i.'s," or personal, mental, financial, or other troubles, tell it to him.

Report to your Flight Surgeon especially when you have symptoms of going "stale." Staleness can pile up from a lot of minor strains on your nerves and muscles, like the strain of monotony, of sitting in one position, of listening by the hour to the radio over the continuous hum of the engines, of watching for enemy planes in every cloud bank, and of ranging your eyes over the instrument panel. Your judgment may become erratic, your reactions may get slow, you don't feel rested after sleep, your appetite is bad, and you "wish to hell you could get away." If you don't tell your Flight Surgeon about this, you are giving your fellow fliers a bad break, for you are putting *them* in danger as well as yourself. There is something else, too: the earlier your Flight Surgeon gets to take care of this kind of thing, the quicker he can get you over it and back to full flying efficiency.

GO TO YOUR FLIGHT SURGEON! He wants to help you. He can help you.

Don't doctor yourself

There is an old Chinese proverb that says "He who treats himself has a fool for a doctor." You can't treat yourself or give yourself medicines of any kind any better than your Flight Surgeon can fly a plane, operate a bomb-sight or radio, read a compass, or do position firing. The only time you should substitute temporarily for the Flight Surgeon is in giving first aid in the air to an injured fellow crew member.

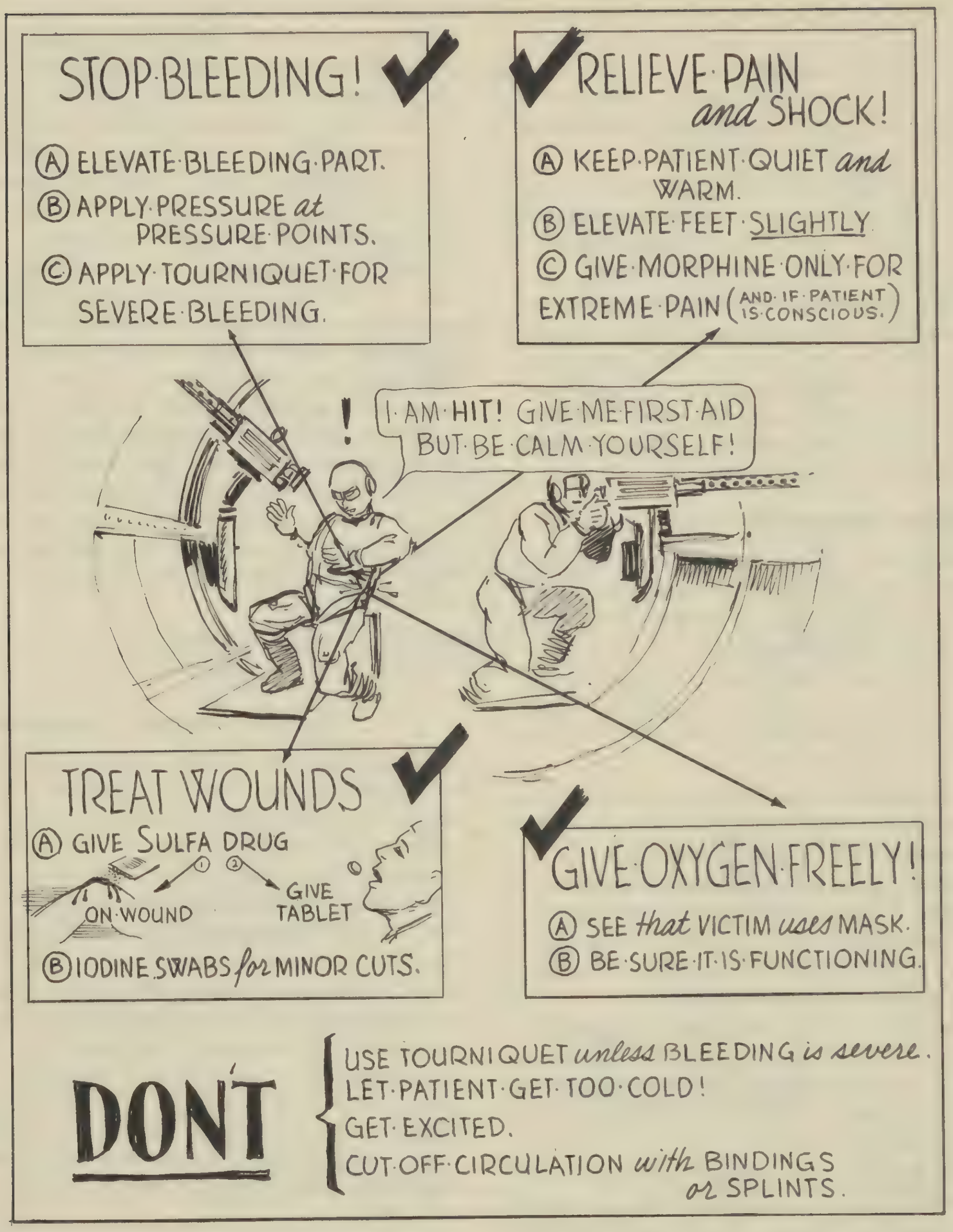
Self-medication is dangerous. For instance, if taken in the wrong way or at the wrong time, the sulfa drugs may make you nauseated, slow down your reactions, and even make you "see things." Benzedrine, a "pep-up" drug, is safe to use only as your Flight Surgeon directs and advises. It may do you harm if you take it "on your own." Even "simple" headache or pain pills may be just the wrong thing for you to take—especially because you are a flier.

DON'T DOCTOR YOURSELF
DON'T TAKE ANY MEDICINE UNLESS YOUR FLIGHT SURGEON ADVISES IT
DON'T BE THE FOOL IN THE CHINESE PROVERB

First aid in the air

You are a flier, not a doctor—yet it is your responsibility to be prepared to save a life!

Many a life has been saved in an airplane by an airman who calmly and intelligently used a few simple first-aid measures. A little thing like placing an injured fellow crew-member in the proper position to combat shock, or pressing your finger in the right place to stop bleeding may mean the difference between life and death.



You must know these few important points in first aid. Each man in a combat crew is that much safer if every member of the crew knows first aid. It is another way of working together. And if you fly a pursuit ship, you will be interested to know that fighter pilots have saved their own lives by first-aid control of bleeding.

THE SIX MAIN RULES OF FIRST AID IN THE AIR.

1. KEEP CALM. The worst thing that can happen to the man you are trying to help is for you to lose your head.

2. SEE THAT THE PATIENT IS GETTING "100% OXYGEN" (AUTO-MIX "OFF"). Do a quick check of his oxygen equipment; see especially that his mask is in place and that his rapid disconnect has not come apart.

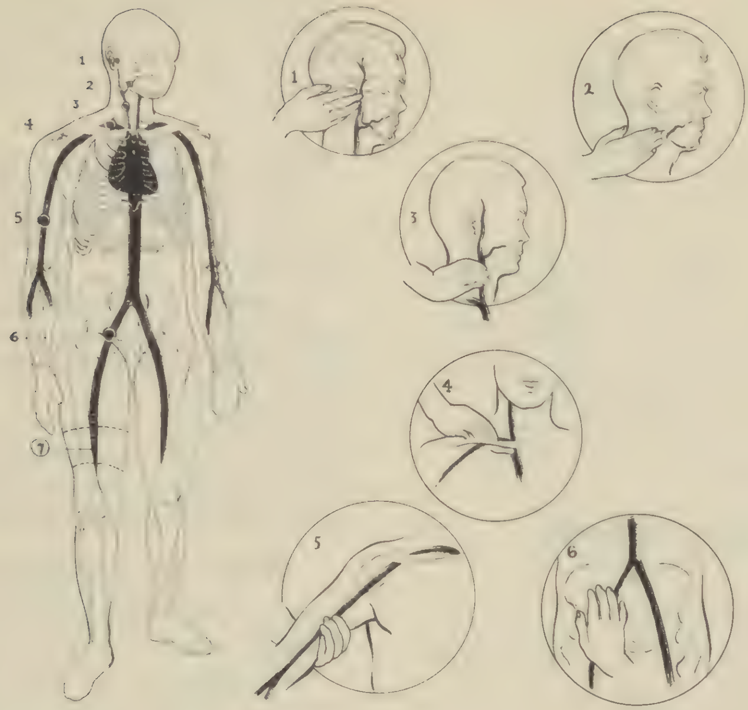
3. STOP BLEEDING. Know the methods!

4. COMBAT SHOCK. Know the methods!

5. RELIEVE PAIN. Use a morphine syrette from the first-aid kit for severe pain. NEVER give morphine if the victim is unconscious, or suffering from oxygen lack, or breathing less than 12 times a minute.

6. GIVE FURTHER TREATMENT of wounds, burns, broken bones, etc. after you have begun the measures outlined in the first five of these six main rules.

The order in which you carry out the first five rules must depend upon the particular situation. At altitude, the first thing to do is to check the oxygen. *When bleeding is severe,* see to the oxygen quickly and then take immediate measures to stop the hemorrhage before you do anything else—then follow with the others as soon as possible.



How to stop bleeding

Pressure Bandage. If bleeding is not severe, you can control it with a bandage pressing tightly on the wound.

Tourniquet—for the arm or leg. If a pressure bandage fails to stop the bleeding from a wound in the arm, leg, foot, or hand, strap on a tourniquet from the first-aid kit. Place the tourniquet as close to the wound as possible—*above* the wound if an artery has been cut (*real spouting* of VERY BRIGHT red blood); below the wound if a vein has been opened (flowing of blood). Do not leave the tourniquet on for more than 15 minutes at a time. Take it off or loosen it for a few seconds every 15 minutes; if necessary, use "pressure point control" while the tourniquet is off. Remove the tourniquet as soon as bleeding is sufficiently controlled.

Pressure Point Control for bleeding from arteries. If a pressure bandage fails to control bleeding from a wound in the head or trunk, use pressure point control. It can also be used for bleeding from an artery in the arm or leg. You press your fingers on the artery and compress it—you can often tell you're on the artery by feeling it throb (pulse) when you first touch it. It is simple with a little practice at putting your fingers on the right point. Here are the "points":

Place of Bleeding	*Pressure Point* (see numbered picture)
1. Bleeding in the scalp above the ear.	1. *Light* pressure in front of the middle of the ear.
2. Bleeding in the cheek.	2. *Very light* pressure in a notch on the under edge of the jaw two-thirds back from the tip of the chin.
3. Bleeding on the outside or inside of the head.	3. *Moderate* pressure on the neck about four fingers' breadth below the ear and two-thirds up from between jaw and collar bone—push artery against spine.
4. Bleeding in the arm.	4. *Firm* pressure behind the middle of the collar bone—push artery against the first rib.
5. Bleeding in lower arm.	5. *Strong* pressure on the inside of the arm halfway between shoulder and elbow.
6. Bleeding in thigh or leg.	6. *Strong* pressure in groin with heel of the hand—push artery against pelvic bone.
7. Bleeding below the knee.	7. *Use tourniquet* between crotch and knee.

How to combat shock

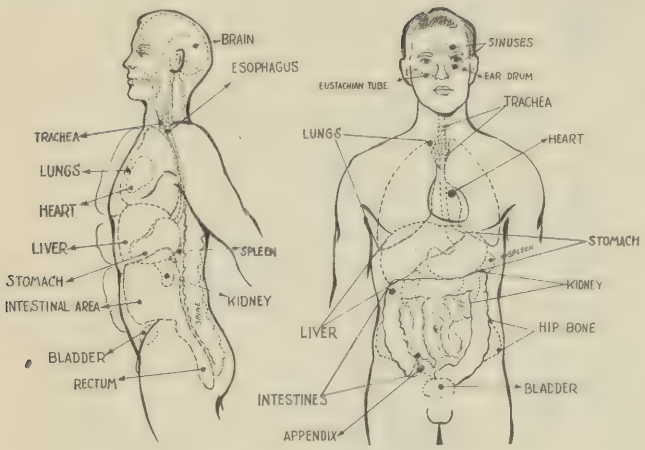
Shock, in which the blood circulation slows down and pools in the belly at the expense of the brain, is most often due to wounds, or loss of blood, or pain, or all of these.

SIGNS OF SHOCK: paleness; cold, clammy skin; weak, but fast pulse; anxiety; sometimes semiconsciousness.

WHAT TO DO:

1. Keep patient quiet and warm.
2. If there is no head injury, keep his head lower than his feet. If there is a head injury, keep him flat.
3. If he is conscious and there is no injury to the abdomen, give him hot coffee from the thermos jug.
4. Of course—give 100 percent oxygen and stop bleeding.

KNOW YOURSELF!



How to treat wounds

IN GENERAL:

1. Cut away clothing around wound.
2. After bleeding has been stopped, sprinkle sulfanilamide powder into wound.
3. Apply bandage from first-aid kit.
4. Give a wounded flier 2 sulfa drug tablets (from the sulfa box in the first-aid kit) to swallow whole every 5 minutes until he has had 12 tablets.

HEAD WOUNDS: Clean mouth and nose frequently with gauze to remove secretions. Laying victim with face down will help to get rid of secretions which interfere with breathing.

CHEST WOUNDS: *Cover* any hole in the chest wall with adhesive tape, or a thick dressing, or both. This stops air from leaking into the chest and collapsing the lung.

WOUNDS OF ABDOMEN: A belly wound might affect any of the organs inside. DON'T let the patient move. *Don't* give him anything to eat or drink. Wrap his abdomen with overlaying pressure bandages to cut down internal bleeding. *Don't* push spilled intestines back through an open wound unless you are absolutely sure they are not punctured. If they are punctured, or if there is any doubt about it, just cover them with gauze compresses kept wet with clean, preferably warm liquid, and keep compresses in place with a snug bandage. If you are sure the spilled intestine is not punctured, sprinkle with sulfanilamide powder, gently press it back into the belly with clean compresses, and then bandage the wound.

How to prevent and treat burns

Burns may occur in combat flying from flaming gasoline, incendiaries, and phosphorus. *But burns can be prevented!*

In combat, no matter what the time, weather, climate, temperature, or altitude, *always wear goggles, oxygen mask, helmet, and gloves*—they are the best protection against possible burns.

To treat burns: Always treat the shock first (oxygen, head low, etc.). Then treat the burns by covering them with burn jelly and *light* bandages. Cover *phosphorus* burns with water-soaked dressings.

How to treat broken bones

Rule Number One here is: Never move a man with a broken bone until you have applied a splint.

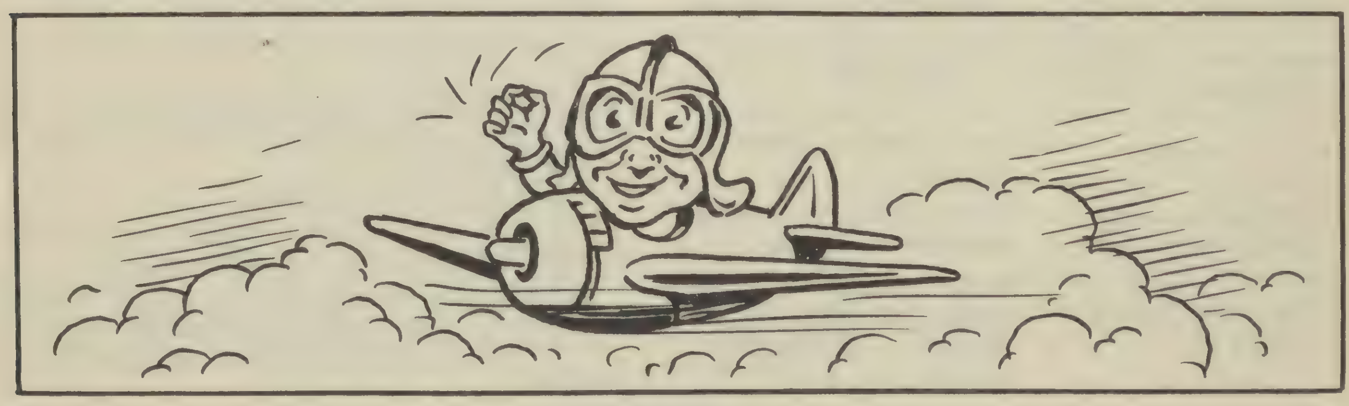
For a splint, use any flat, straight, firm material that can brace the arm or leg. Straighten (extend) the limb gently and steadily, then apply the splint the full length of the limb. Bind the splint on firmly, but not so tight that it will stop circulation of the blood—feel for a pulse on the wrist, hand, ankle, or foot.

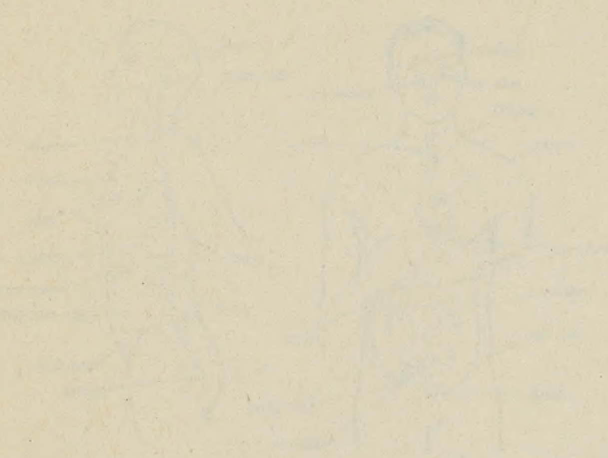
If the bone has punctured the skin and sticks out: first treat like a wound—stop bleeding, sprinkle with sulfa powder, and bandage. *Then* put on the splint.

The first aid kit

Make sure the first-aid kit is in your plane. It should not *ever* be moved unless you have to bail out, and then, if possible, take it with you. A smaller kit is provided for attachment to your parachute if the larger one is not handy.

DON'T FORGET: Your "course" in first aid is not complete unless you know how to revive and take care of a fellow crew-member who has passed out from lack of oxygen; and how to treat frost-bite. These first aid procedures are covered in the sections on oxygen equipment and on how to protect yourself in the sub-zero temperatures of altitude.





How to treat wounds

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How to prevent and treat burns

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How to treat broken bones

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The first aid kit

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